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Contributors and Contributions

W. M. Wilkie on Heat Treatment

The study of the heat treatment of steel is now at the forefront, as evidenced by the formation recently of the American Steel Treaters' Society (see page 299) and the previous organization of a Detroit society devoted to heat treating. It is an opportune time, therefore, to publish the paper, which appears in this issue, on the Heat Treatment of Low-Carbon Steel, contributed by the Ontario Section of the A. S. M. E. The author, Mr. W. M. Wilkie, of the Imperial Munitions Board, Toronto, is eminently qualified to discuss the subject.

Airplane Engineering Data

It is the policy of the Publication Committee to extend the Engineering Survey Section of MECHANICAL ENGINEERING in so far as space will permit. Occasionally articles appear of such extent and of so great value that it is deemed best to take them out of the regular Survey section and publish as separate articles. Two articles of this kind appear in this number, on Liberty-Engine Tests (the first authentic presentation) and the Loomis Aircraft Cooling System. These were prepared from confidential Bulletins of the Experimental Department, Airplane Engineering Division, McCook Field, Dayton, Ohio, and are published by special permission of the Department.

Thirtieth Anniversary of Ericsson's Death

There hangs in the rooms of the Society an oil portrait of John Ericsson which is reproduced in this number, with anecdotes of Ericsson, in commemoration of the thirtieth anniversary of his death, which occurred on March 9, 1889.

Fuel Administration, National and State

From across the continent has been received a collection of discussions by a group of the most prominent fuel engineers on the Pacific Slope, covering the fuel problems encountered there during the last year of the war. These form a valuable addition to the notable symposium on this subject presented at the Spring Meeting of 1918 at Worcester, Mass. The discussions bear largely on the possibilities of fuel oil conservation, both through its economical use and the development of hydraulic power. Supplementing this is published a summary of the work of the National Fuel Administration, by David Moffat Myers, and of the very thorough planning and organization of the work in Missouri, the latter contributed by Prof. H. Wade Hibbard, Mem. Am. Soc. M. E., of Columbia, Mo.

Henry L. Hess on Electric Furnaces

From another Section comes a paper on Electric Furnaces as Applied to Steel Making, by Mr. H. L. Hess, son of Mr. Henry Hess, chairman of the Standardization Committee of the A. S. M. E. This paper was greatly appreciated by the engineers who heard it at Baltimore where it was presented, and at the time a special request was made by the Section's officers that it be given early publication for the benefit of the readers of MECHANICAL ENGINEERING generally.

Return of Engineer-Delegates from France

On invitation of certain engineering organizations of France, representatives of the National Engineering Societies of the United States visited France to confer on rehabilitation problems. These engineers have just recently returned and given their views and experiences at meetings in Boston and New York, which are reported in this number.

Stresses in Wire Ropes

At the last Annual Meeting a scholarly paper was presented by J. F. Howe, wire-rope engineer of the American Steel and Wire Company, on Stresses in Wire Rope. There is published a discussion of the paper by Mr. S. Hardesty of Kansas City, Mo., in which he considers conditions for both old and new ropes; and ordinary rope compared with rope having straight wires.

News Matter from Many Sources

Many happenings are reported this month of general interest in the engineering field. Under "Among the Sections" of the A. S. M. E. will be found Dean Cooley's first address as President of the Society; and in the reports of other societies, which include accounts of the recent S. A. E. and H. & V. meetings, will be found a stirring address by Past-President Hollis delivered before the Engineering Institute of Canada. Secretary Rice comments on conditions as he found them during an extended trip through the West and South. The general topics treated include reference to the opening of a Washington Office by Engineering Council; Educational Work of our Army Abroad; Manufacture of Precision Gage Blocks by the Bureau of Standards; Reports of Researches by the Research Committee; Account of the Personnel of the large and representative Committee on Aims and Organization of the Society; the Training of Workers as a Society Activity; the Gage Laboratories of the Bureau of Standards; and many others.

The Spring Meeting

To be Held at Detroit, June 16-19, 1919

THE SPRING MEETING this year will start on *Monday*, June 16, instead of Tuesday, the usual day for the beginning of the Society's conventions. This will enable most of those who attend to leave home on Saturday or Sunday, arrive in Detroit in time for a business meeting on Monday, and reach home again before the close of the week.

Preparations for the meeting are now under way in high gear. The Committee on Meetings and the Detroit Local Committee have already been in conference regarding the professional and entertainment features, and a fine program is assured. Detroit is *the* city which at the present time it will be of the greatest interest to visit, and a large attendance is expected. Details later. The main thing now is to reserve the dates of June 16 to 19 inclusive.

Coming Sections Meetings

March 3: Meeting of the members of the Minnesota Section at the St. Paul Association of Commerce.

March 5: The Birmingham Section will hear a paper on Technical Training Inside and Outside of College, to be read by H. L. Freeman of The Tennessee Coal, Iron and Railroad Company.

A meeting of the Buffalo Section will be held, probably at the Hotel Statler.

March 12: The members of the New Haven Branch will meet at Yale University.

March 21: A joint all-day meeting is planned in Atlanta, in which the members of the Baltimore, Birmingham, Atlanta and New Orleans Sections will participate, and to which the members of the Society in Cuba are invited.

The St. Louis Section will hold its regular monthly meeting at the Hotel Statler.

March 25: The March meeting of the Philadelphia Section will be held at the Engineers' Club. An address will be delivered by J. W. Frazier of the U. S. Shipping Board on The Development of Port and Harbor Facilities to Meet After-War Demands.

HEAT TREATMENT OF LOW-CARBON STEEL

Characteristic Structures Found in Steel, Their Formation by Heat Treatment and the Effect Each Has on the Quality of the Steel

By W. M. WILKIE, TORONTO, ONT.

STEEL is made up of iron combined with certain percentages of carbon, manganese, silicon, phosphorus, sulphur and other elements, each one of which by its presence in varying quantities imparts some special quality to the steel. It is, however, the writer's intention to confine himself to a study of the more usual combinations of iron and carbon that exist in low-carbon steels, for the whole subject of heat treatment is really a study of the different forms or phases in which the various combinations of iron and carbon exist, and the conditions under which they are formed. That is, knowing the particular quality a certain form or phase imparts to steel, and the treatment required to produce it, we are in a position to prescribe the treatment necessary for producing steel of any desired quality.

From microscopic examinations of polished and etched sections of steel, it has been found that there are a number of characteristic structures under which steel exists, each being the result of some special treatment. To determine these characteristic forms and the reason for their formation, a study should be made of the different kinds of treatment that steel receives in ordinary commercial practice and the results of these various treatments. The subject may be divided as follows:

1 Unworked steel, i.e., cast steel { cooled slowly / cooled rapidly / reheated

2 Hot-worked steel { cooled slowly / cooled rapidly / reheated

Cast Steel Cooled Slowly

In molten steel the carbon exists as chemical compounds of iron and carbon of varying composition, called carbides. The most common of these has the composition FeC_3 and is called cementite. These carbides are found dissolved in the molten iron in the same way as salt is dissolved in water; also as the steel solidifies, the carbides continue in solution and form what is known as a "solid solution."

The solid solution of iron and the carbide FeC_3 is called austenite, and is the usual form or phase that iron is found in just after freezing.

Austenite, owing to its instability at lower temperatures, is rarely ever found in steel unless special precautions are taken, such as by cooling very rapidly from temperatures above 1000 deg. cent. (1768 deg. fahr.) It has a crystalline structure, which becomes coarser the slower the steel is cooled, due to the fact that as no mechanical work has been done on the steel, adjacent crystals tend to assume the same orientation and merge into a larger crystalline grain. Such slowly cooled, coarse-grained steel is brittle, has minimum tenacity and toughness, and can only be used where it is possible to make up strength by using large masses of metal.

Along with the growth in the size of the grains, the rate of cooling is uniform until a temperature somewhere between 900 deg. cent. and 700 deg. cent. (1652 and 1292 deg. fahr.) is reached. At this point the rate of cooling is gradually retarded, until finally the temperature becomes either stationary or even slightly higher. After a short interval the temperature will again fall at a gradually increasing rate until it becomes uniform, at which it continues to cool to atmospheric temperatures.

The explanation of this peculiar phenomenon is that a change occurs in the structure of the steel during this change of temperature, caused by the austenite, now having reached a temperature at which it is no longer stable, proceeding to change into the more stable phases of lower temperatures. This change is accompanied by a liberation of heat, which explains the change in the rate of cooling. A similar but reverse action takes place when steel is being heated.

The range of temperature within which this change occurs is called the critical range, while the upper and lower limits of this range are known as the upper and lower critical points. The lower point is about 690 deg. cent, (1274 deg. fahr.) for all percentages of carbon content, whereas the upper point ranges from 900 deg. for pure iron to 690 deg. for steels containing 0.85 per cent carbon. These points also vary slightly with the amounts of other elements besides carbon present, also depending on whether the steel is being heated or cooled. The critical range and its limits are important points to remember in heat treatment, and it is necessary to become thoroughly familiar with the reactions that occur in this range.

The slow-cooling steel under consideration has now reached the upper critical point where the martensite is no longer stable and begins to change into some more stable form such as pearlite, ferrite or cementite.

Pearlite is a definite mechanical (not chemical) mixture of the carbide FeC_3 with pure iron or "ferrite," with a carbon content of 0.85 per cent. Steels having such a carbon percentage will, after annealing, be all pearlite and are known as "eutectoid" steels. If the carbon content is *less* than 0.85 per cent, all the carbon is combined with iron to form the carbide FeC_3 or cementite, which by the addition of a further amount of iron immediately is converted into pearlite, while any excess iron is left free. Such steel is called hypoeutectoid steel, and consists of pearlite and ferrite when in the annealed condition.

If the carbon content is *over* 0.85 per cent, there will be an excess of cementite over the amount required to make pearlite from the free iron present, and so we have the two phases, cementite and pearlite, when the steel is annealed. Such steel is known as hypereutectoid steel.

Pearlite is a constituent of all slowly cooled steels, the greater the proportion of carbon—and hence of pearlite—the stronger and tougher and less ductile will be the steel, until the eutectoid composition is reached, when the steel has maximum strength, as all additions of carbon above this composition only result in the formation of cementite, which has no strengthening power.

Pearlite also by its ability to take up free ferrite and change into austenite is the hardening constituent of steel, so that eutectoid steel is the composition that has maximum hardening powers, though eutectoid steels are not necessarily the hardest, as hypereutectoid steels may be harder as the result of the hardness caused by the presence of cementite.

Ferrite is the name of pure iron and it is the constituent of all low-carbon slowly cooled steels. It is very soft, ductile, relatively weak, and has no hardening power.

Cementite is a substance about which little is known. It is a definite chemical compound, FeC_3, and it may be assumed that it is very hard and brittle, and therefore lacks tenacity and ductility. It has no hardening power beyond the extreme hardness it itself confers on the steels.

The properties of these three constituents of steel as given by Howe are set forth in Table 1.

When the slow-cooling steel has reached the upper critical point, it will be coarse grained because of the very slow cooling. At this point each grain of austenite tends to transform into the pearlite composition by throwing off the excess ferrite or cementite it contains, and if the cooling is carried on with sufficient slowness, it will be found that by the time the lower critical range is reached each original grain of austenite has changed into the pearlite or eutectoid composition, while the excess iron in the hypo-eutectoid steels, or the excess cementite in the hypereutectoid steels, has been liberated as follows:

[1] Imperial Munitions Board, Toronto.

Paper presented at a meeting of the Ontario Section of The American Society of Mechanical Engineers, Toronto, April 18, 1918.

TABLE 1 PROPERTIES OF CONSTITUENTS OF STEEL

Constituent	Tensile strength, lb. per sq. in.	Elongation, per cent	Hardness	Hardening power
Ferrite..........	50,000	40	Soft	None
Pearlite.........	125,000	10	Hard	Maximum
Cementite.......	5,000 ?	0	Very hard	None

1 As a film or envelope around the original grains
2 Between the cleavage planes of the crystalline grains
3 As a combination of both.

The first form results with fairly rapid cooling, whereas the second form is the result of very slow cooling.

As the steel cools past the lower critical range the changes are all completed, and any further cooling has no effect on the internal structure, provided it is not rapid enough to set up strains.

Having followed the changes in a slow-cooled cast steel, it is found that the final condition is a coarse-grained, softened steel, which owing to its coarse-grained structure lacks strength, toughness and ductility, but is relatively soft, and has for its constituents the phases pearlite, combined with either ferrite or cementite, depending on the carbon content.

Cast Steel Cooled Rapidly

In cooling steel very rapidly, by quenching it in oil or water, we find marked differences from the slowly cooled steel. First, the grain structure is finer, the growth of the grains being prevented. Second, the steel is very hard and brittle, because the reaction in which austenite transforms into pearlite, with a residue of ferrite or cementite, can only take place completely when the cooling is very slow. If the steel is cooled rapidly, the reaction only partially takes place, and as a result there are a number of new phases formed which are really part-way transformations between the austenite phase and the phases of soft steel.

The most important of these forms is martensite. This is really an allotropic form of austenite, whose most characteristic features are its needle-like structure, with the crystals crossing each other at 60 deg., and its extreme hardness. It is formed by quenching steel in water, if the pieces are fairly large, or in oil in case of small objects, from above or near the upper critical point. This rapid cooling causes rapid contraction, which sets up great pressures and results in the crystals assuming the structure indicated above.

Martensite is the form or phase giving maximum hardness to steel, so that the more rapid the cooling and, consequently, the greater the amount of martensite, the harder and more brittle will be the steel. Extremely brittle steel is, however, of very little use commercially.

If the steel instead of being quenched in water is either allowed to cool slowly to the middle critical range and then quenched, or is quenched in oil in case of small sections, another form, called troostite, is formed. This is a further stage in the transformation from austenite into pearlite, i.e., the grains have gone a step further toward reaching the eutectoid composition. Troostite occurs in dark-colored, irregular areas or nodules, and is nearly always accompanied by martensite and sorbite. It is slightly softer and has more ductility and toughness than martensite.

If the steel instead of being quenched in oil or water is cooled rapidly in air, or a large piece of steel is quenched in oil, a new constituent called sorbite is formed, which is another stage in the transformation of austenite into pearlite. It is considerably softer than martensite, and in fact is not a constituent of hardened steel. Its properties more nearly approach that of pearlite, i. e., it is stronger, harder and less ductile than pearlite, but softer and more ductile than troostite. Its composition also approaches more closely to the pearlite composition than the solid solution of iron and ferrite found in austenite; in fact, sorbite is the last stage in the transformation from austenite to pearlite.

Accordingly, unworked steel cooled slowly contains the phases of soft steel, but owing to the coarse-grained crystalline structure it is brittle and lacks strength and ductility. Similarly with rapidly cooled unworked steel the rapid cooling tends to retard the growth of large grains, but unless great precautions are taken to cool the steel very rapidly, it will still have a fairly coarse granular structure, which, combined with the brittleness caused by rapid cooling, leaves a material having little commercial value.

Cast Steel Reheated

To overcome these difficulties it is necessary to give the steel some special heat treatment—in this case, annealing. Theoretically, in annealing the steel should be heated to the upper critical point, and then cooled slowly, but the rate of cooling has to be varied, depending on the particular steel required.

The theory of this treatment is that as the steel is heated above the lower critical point, the phases of softened steel, i. e., pearlite, ferrite, and cementite, tend to change into austenite. This reaction continues through the critical range accompanied by the absorption of heat which causes a retarding in the rate of heating, similar but opposite to the action in cooling, and when the upper critical point is reached it is found that the steel has been all converted into martensite, provided sufficient time has been given in heating to permit this reaction to occur completely. The result of this transformation is to break the coarse-grained crystals into a finer-grained or even an amorphous structure.

Such is the treatment required theoretically, but in cast steel there are certain conditions that prevent the reaction from occurring as expected, so that it becomes necessary to soak the steel for a long time at temperatures considerably above the upper critical point before obtaining an annealing action. These conditions will be discussed in detail under annealing.

In the case of cast steels which have been quenched (unlikely in actual practice), we have the usual hardening of steel. Any reheating will result in changes similar to tempering. Hardening and tempering will be discussed in later paragraphs.

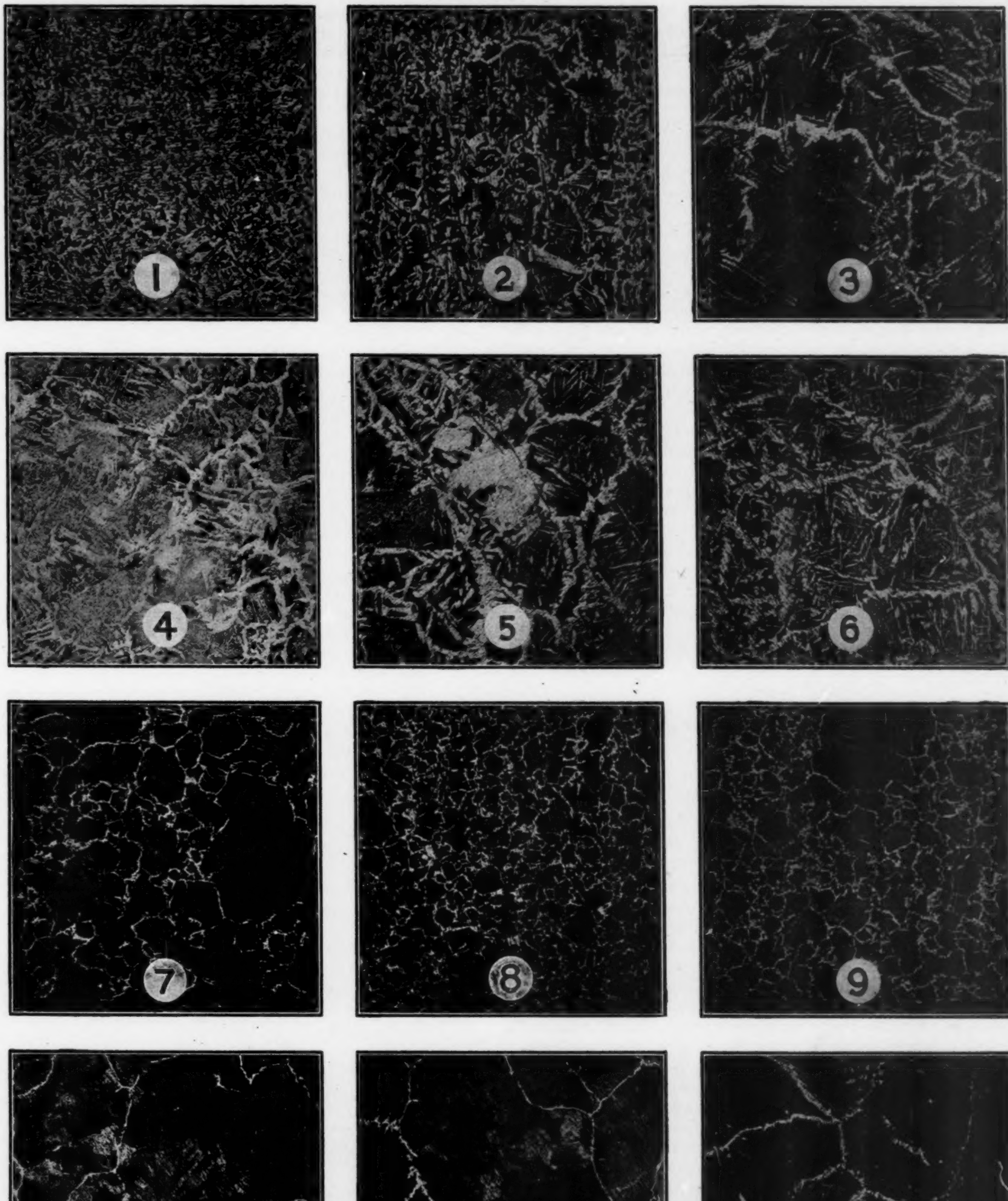
Hot-Worked Steel Cooled Slowly

In cast steel it was found that the size of grain structure was dependent on the rate of cooling, but with steel subjected to mechanical treatment such as rolling or forging, we find that the crystalline growth is much slower, if not altogether discontinued, during the time the steel is being so treated. The extent of this retardation of the crystalline growth is controlled by:

1 *The nature of the work being done.* Light hammering, with only a slight reduction in size, may leave the steel almost like cast steel, while pressure under a hydraulic press, combined with a large reduction in area will leave it with a fine-grained or even amorphous structure. The latter is an ideal condition.
2 *The temperature at which work was stopped.* As soon as we discontinue working the steel the growth of size of crystalline grain again commences and continues to the upper critical range.
3 *Rate of cooling from time of completion of work to the upper critical point.*

If steel is cooled slowly from the temperature at which work was stopped (especially if this temperature was high) to the upper critical point, the result is a coarse-grained structure of the phases of softened steels. Due to the relatively large grains of pearlite the tensile results, including the elongation, will be found to be low. This is a condition frequently met in the forging of shells where the finishing temperatures are around 1800 deg. fahr. or even higher. In high-carbon heats the forging manufacturers attempt to soften the steel by long-continued cooling, and if this rate of cooling is sufficiently slow we reach the above conditions and find heats failing on yield with an ultimate strength of about 43 tons, where the normal results should be 50 tons and over. To overcome this condition it is necessary to carefully anneal the steel to remove the coarse-grained structure.

Where the mechanical treatment is continued to the upper critical point the structure is fine-grained and is in its ideal condition, but the cost of working steel down to this temperature usually forbids it, so that any crystalline structure that is formed between the finishing temperature and the upper critical point must



FIGS. 1 TO 12 PHOTOMICROGRAPHS SHOWING CHANGE IN GRAIN STRUCTURE CAUSED BY ANNEALING TO VARIOUS TEMPERATURES. SEE NOTES UNDER TABLE 3.

be removed by reheating (annealing) the steel to the upper critical point and then cooling either slowly or rapidly, depending on the product required.

Annealing of Steel. The purpose of annealing steel is—

1 To increase the softness and ductility of steel in cases where it is too hard for machining;
2 To remove strains and refine grain structure and reduce brittleness or other defects caused by:
   a High finishing temperature while hot-working, leaving a coarse-grained structure
   b Coarse granular structure due to slow cooling as in castings
   c Strains caused by cold-working of steel below critical temperature;
3 To soften steels too hard and brittle as the result of too rapid cooling.

In annealing the operation consists in (1) slowly raising the steel to its upper critical temperature; (2) holding it or soaking it at this temperature for a certain time depending on size of piece being treated and condition of previous treatment; and (3) cooling from annealing to atmospheric temperature.

Theoretically, as the steel is heated to the lower critical point the usual transformation from the phases of softened steel to austenite is commenced, and continues through the critical range, so that when the upper critical point is reached the steel should be all austenite. As a result of this transformation all preëxisting structures, no matter how coarse, are obliterated and the mass assumes an amorphous structure, providing sufficient time has been taken in heating to permit these changes to occur.

Further, if the temperature is carried above the upper critical point the tendency is for this amorphous structure to again become crystalline. Hence, in annealing steel its temperature should theoretically be raised to the upper critical point only, but practically there are conditions that modify this. For example, in cast steels we find that temperatures considerably higher (as much as 100 deg. cent. above the theoretical temperatures), combined with long soaking, are required to break up the coarse-grained structure. The reason for this is rather obscure. One theory that has been advanced claims that each grain in cast steel is surrounded by a film of sulphides, phosphides and silicides of iron which prevents the crystals from breaking up under ordinary treatment, but with long soaking at high temperatures these impurities tend to migrate to the center of the grains and leave the surface of the crystals free to break up.

TABLE 2 ANNEALING TEMPERATURES FOR STEEL

Range of Carbon Content	Range of Annealing Temperatures	
	Deg. Cent.	Deg. Fahr.
Less than 0.12 per cent	875 to 925	1607 to 1697
0.12 to 0.25 per cent	840 to 870	1544 to 1598
0.30 to 0.49 per cent	815 to 840	1499 to 1544
0.50 to 1.00 per cent	790 to 815	1454 to 1499

Mechanical work on steel seems to have the same effect, i. e., it breaks up this intercrystalline film, and as a result we find that the more a piece of steel has been worked the closer the annealing temperatures can be kept to the upper critical point, while the nearer the steel is to the unworked or cast condition the higher the temperatures must be. The ranges of temperatures given in Table 2 have been recommended by the Committee on Heat Treatment of the American Society for Testing Materials.

The time of soaking depends largely upon the size of the object being annealed, but sufficient time should be given to permit the object to be heated throughout to the annealing temperature and allow the internal changes to occur. Pieces 12 in. thick require about one hour.

Hot-Worked Steel Cooled Rapidly

The rate of cooling after annealing is controlled by the product required. If a maximum softness and ductility is desired, i. e., for easy machining, we cool as slowly as possible, by either burying the article in a bed of insulating material or allowing it to cool in the furnace. If, however, we wish to retain a certain amount of hardness and strength we must cool faster, as in air or, if a very low-carbon steel, in water, but to do so we must sacrifice a certain amount of ductility and softness. As a general rule, the lower the carbon the more rapid may be the cooling. For example:

a Steels with carbon contents below 0.15 per cent can be quenched in water and remain ductile and at same time have maximum hardness and strength.
b Steels with carbon contents below 0.20 per cent can be quenched in oil with results similar to 0.15 per cent carbon quenched in water.
c Steels with carbon above 0.30 per cent cannot be cooled so rapidly without destroying the ductility of the steel and so must be either cooled in the furnace, or in the air when extreme softness is not required.

The size of objects must also be considered along with the product desired. Other things being equal, the larger the object the more quickly must it be cooled, so long as the cooling is not too rapid to set up strains.

As an example of the effect of rate of cooling on the strength of steel, we have a system of strengthening steels on high-explosive shells known as the Sandberg air-cooling method. By this method air at pressures ranging from 6 oz. to 15 oz., usually around 10 oz., is either passed around the shell forging or forced to impinge on the revolving shell in such a way that a shell that would normally cool in about thirty minutes or more in the open air, is cooled in six to eight minutes. As a result the ultimate strength is raised from 4000 to 10,000 lb., with an increase in the elastic ratio but with very little variation in the ductility of the steel. This process is really an intermediate treatment between annealing and the regular hardening of steel, due to the formation of sorbite, which, as explained before, is a transformation phase between martensite and pearlite. Another way to get this sorbitic steel is to first quench steel from the upper critical range, thus retaining its fine-grained structure but leaving the steel very hard and without ductility. The steel is now reheated close to but below the lower critical range, say, from 500 to 650 deg. cent. (932 to 1202 deg. fahr.), when it loses its hardness and becomes ductile. The reason for this is that the steel has been changed from martensite to sorbite. This is really a hardening and tempering treatment, but is referred to here because it is sometimes called a double annealing treatment.

Photomicrographs of Annealed Steel. The photomicrographs reproduced in Figs. 1 to 12 illustrate graphically the distinct change in grain structure caused by annealing to various temperatures. Figs. 1 to 6 apply to one grade of steel, *A*, and Figs. 7 to 12 to another grade, *B*. The properties of these steels, after ordinary forging, but before annealing, are given in Table 3.

TABLE 3 ANALYSES AND PROPERTIES OF ANNEALED STEELS *A* AND *B*

Steels	Carbon, per cent	Manganese, per cent	Phosphorus, per cent	Sulphur, per cent	Stretch at 19 tons	Ultimate breaking load, tons	Elongation, per cent
A	0.40	0.61	0.062	0.057	0.0	40.3	26.0
B	0.55	0.80	0.058	0.057	0.0	47.9	18.5

HEAT TREATMENT

Figs. 1 and 7: Samples heated to 1500 deg. fahr., held for 2 hr., withdrawn, and cooled in air.

Figs. 2 and 8: After the above heat, samples were heated to 1600 deg. fahr., held for 1½ hr., withdrawn, and cooled in air.

Figs. 3 and 9: After the above heats, samples were heated to 1700 deg. fahr., held for ½ hr., withdrawn, and cooled in air.

Figs. 4 and 10: After all the above heats, samples were heated to 1900 deg. fahr., held for ½ hr., withdrawn, and cooled in air.

Figs. 5 and 11: After all the above heats, the samples were heated to 2100 deg., held for 20 min., withdrawn, and cooled in air.

Figs. 6 and 12: After all the above heats, samples were heated to 2275 deg. fahr., held for 20 min., withdrawn, and cooled in air.

In samples *A* the grain structure increases progressively from the start. In samples *B* the grain is finest at 1600 deg. fahr., Fig. 8, and increases thereafter. At 1900 deg. fahr., Fig. 10, signs of overheating appear, while samples *A* show damage only in Fig. 6, at 2275 deg. fahr.

Hardening of Steel. The most common constituents of hardened steel are martensite and troostite, and as we know the conditions under which they are formed, it is only necessary to treat the steel so as to produce either or both, depending on the hardness required.

To obtain martensite the steel must be raised to the upper critical range so as to transform the pearlite and ferrite, or pearlite and cementite, into austenite. We must not let the temperature rise above the upper critical point, as by so doing we coarsen the structure, and our aim should be to keep this as fine as possible. So we should quench the steel just as it issues from the upper critical range in the quenching medium selected, due to the fact that long exposures to temperatures above the critical point will increase the grain size. However, in deciding on the temperatures to be used we must consider the previous work and treatment given the steel. For example, a piece of cast steel will require considerably higher temperatures for reasons similar to those given under annealing, while steel that has had considerable work done on it (especially when work is continued down to the upper critical range) need only be heated to the upper critical range before quenching. The hardening temperatures in Table 4 are given by E. F. Houghton & Co.

TABLE 4 RELATION OF HARDENING TEMPERATURE TO CARBON CONTENT

Carbon Content	Hardening Temperature to Use	
	Deg. Cent.	Deg. Fahr.
Up to 0.20 per cent	871 to 899	1600 to 1650
0.20 to 0.35 per cent	843 to 871	1550 to 1600
0.35 to 0.50 per cent	815 to 843	1500 to 1550
0.50 to 0.70 per cent	787 to 815	1450 to 1500
0.70 to 0.90 per cent	760 to 787	1400 to 1450
0.90 per cent or over	732 to 760	1350 to 1400

It is difficult in quenching steel to control the percentage of martensite and troostite that will result, or, in other words, to get uniform results from hardening alone, as the various factors that control these percentages as size of piece, rate of cooling, etc., vary so much. So the practice is to endeavor to get the maximum amount of martensite by as rapid a cooling from above critical point as is permissible without unduly setting up cooling strains which might rupture the metal. This leaves the metal too hard and brittle for ordinary requirements, but by tempering we can arrive at any degree of hardness or toughness required.

Steel is most commonly quenched in oil or water. In either case care must be taken, especially with high-carbon steels, to prevent cracking as the result of strains set up by too rapid cooling. If oil or water is used the object should be withdrawn from the bath before its temperature has fallen below 100 deg. cent. (212 deg. fahr.), and the drawing or tempering treatment should follow immediately.

Hot-Worked Steel Reheated (Tempering)

Steel that has been hardened is generally harder and more brittle than is necessary, and in order to bring it to the condition that meets our requirements a treatment called tempering is used. This increases the toughness of the steel, i. e., decrease the brittleness at the expense of a slight decrease in hardness.

There are several theories to explain this reaction, but generally it is only necessary to remember that in hardening we quench steel from the austenite phase, and, due to this rapid cooling, the normal change from austenite to the eutectoid composition does not have time to take place, and as a consequence the steel exists in a partially transformed and unstable condition at ordinary atmospheric temperatures. But owing to the strains and rigidity set up by this rapid cooling the steel is unable to change into its more stable phase until these strains are removed by the application of heat. The higher the heat, the greater the transformation into the softer phases. As the transformation takes place, a certain amount of heat of reaction, which under slow cooling would have been released in the critical range, is now released and helps to cause a further reaction, the result of which is that if a piece of steel is heated to a certain temperature and held there, the tempering color, instead of remaining unchanged at this temperature, will advance in the tempering-color scale as it would with increasing temperature. This means that the tempering colors do not absolutely correspond to the temperatures of steels, but the variations are so slight that we can use them in actual practice.

Temperatures to Use. As soon as the temperature of the steel reaches 100 deg. cent. (212 deg. fahr.) the transformation begins, increasing in intensity as the temperature is raised, until finally when the lower critical range is reached, the steel has been all changed into the ordinary constituents of unhardened steels.

If a piece of polished steel is heated in an ordinary furnace, a thin film of oxides will form on its surface. The colors of this film change with temperature, and so, in tempering, they are generally used as an indication of the temperature of the steel. The steel should have at least one polished face so that this film of oxides may be seen.

An alternative method to the determination of temper by color is to temper by heating in an oil or salt bath. Oil baths can be used up to temperatures of 500 deg. fahr.; above this, fused-salt baths are required. The article to be tempered is put into the bath, brought up to and held at the required temperature for a certain length of time, and then cooled, either rapidly or slowly. This takes longer than the color method, but with low temperatures the results are more satisfactory, because the temperature of the bath can be controlled with a pyrometer. The tempering temperatures given in Table 5 are taken from a handbook issued by the Midvale Steel Co.

TABLE 5 TEMPERING TEMPERATURES FOR STEELS

Temperature for 1 hour		Color	Temperature for 8 min.		Uses
Deg. F.	Deg. C.		Deg. F.	Deg. C.	
370	188	Faint yellow	460	238	Scrapers, brass-turning tools, reamers, taps, milling cutters, saw teeth
390	199	Light straw	510	265	Twist drills, lathe tools, planer tools, finishing tools
410	210	Dark straw	560	293	Stone tools, hammer faces, chisels for hard work, boring cutters
430	221	Brown	610	321	Trephining tools, stamps
450	232	Purple	640	337	Cold chisels for ordinary work, carpenters' tools, picks, cold punches, shear blades, slicing tools, slotter tools
490	254	Dark blue	660	349	Hot chisels, tools for hot work, springs
510	265	Light blue	710	376	Springs, screw drivers

It will be noted that two sets of temperatures are shown, one being specified for a time interval of eight minutes and the other for one hour. For the finest work the longer time is preferable, while for ordinary rough work eight minutes is sufficient, after the steel has reached the specified temperature.

The rate of cooling after tempering seems to be immaterial, and the piece can be cooled at any rate, providing that in large pieces it is sufficiently slow to prevent strains.

How are we to know if we have given a piece of steel the very best possible treatment? The best method is by microscopic examination of polished and etched sections, but this requires a certain expense for laboratory equipment and upkeep, which may prevent an ordinary commercial plant from attempting such a refinement. However, I would certainly recommend any firm that has any large amount of heat treatment to do, to install such an equipment, which can be purchased for from $250 to $500. Its intelligent use will save its cost in a very short time.

The other method is by examination of fractures of small test bars. Steel heated to its correct temperatures will show the finest possible grain, whereas underheated steel has not had its grain structure refined sufficiently, and so will not be at its best. On

the other hand, overheated steel will have a coarser structure, depending on the extent of overheating.

To determine the proper quenching temperature of any particular grade of steel it is only necessary to heat pieces to various temperatures not more than 20 deg. cent. (36 deg. fahr.) apart, quench in water, break them, and examine the fractures. The temperature producing the finest grain should be used for annealing and hardening.

Similarly, to determine tempering temperatures, several pieces should be hardened, then tempered to various degrees, and cooled in air. Samples, say six, reheated to temperatures varying by 100 deg. from 300 deg. cent. to 800 deg. cent. will show a considerable range of properties, and the drawing temperature of the piece giving the desired results can be used.

Precautions to be Used in Heat-Treating. The following precautions should be observed in the heat treatment of steel:

1 Do not put a cold piece of steel into a highly heated furnace. Either reheat it or put it into a cold furnace and allow it to heat up with the furnace. This precaution is especially applicable in cold weather. Also remember that the changes occurring in the critical range are not instantaneous. The steel must be given time to change. It does not pay to rush the heating. Raise the temperature slowly.

2 Allow the piece to soak at the quenching temperature until it is uniformly heated throughout, the length of time depending on the size of the piece and the rate of heating.

3 Do not allow the piece to be directly on the hearth of the furnace, but have it supported at a sufficient height to allow a free circulation of gases on all sides. Long pieces should have sufficient support to prevent sagging.

4 Never allow a piece, especially if it has points or sharp corners, to come in contact with flame.

5 In quenching, immerse the piece with the axis vertical. This will prevent excessive warping or cracks due to unequal contraction in cooling.

6 Care should be taken that no sharp grooves, corners or seams are left on pieces to be quenched, which may develop into cracks.

7 In drawing the temper of a large piece in a furnace never put a piece into a furnace hotter than the drawing temperature nor allow the furnace to exceed the required temperature, otherwise the steel will be softer than required.

8 In drawing large pieces, soak a sufficient time at the desired drawing temperature, to allow the heat to affect the center of the piece.

9 In annealing and quenching never depend on the eye to judge the temperature; use a pyrometer.

RESULTS OBTAINED—SANDBERG AIR-COOLING TREATMENT

[In an appendix to his manuscript the author gave details of the results obtained in heat-treating cast-steel billets for large shells to meet the specified requirements of 19 tons yield, 35 to 49 tons ultimate breaking load, and 14 per cent elongation in a 2-in. test piece. For example, a cast-steel blank containing 0.60 per cent carbon and 0.87 manganese was soaked for four hours at 1575 deg. fahr., allowed to cool in the furnace to 1350 deg. fahr., removed from the furnace and cooled quickly to black in air; then reheated to 1275 deg., soaked for 2½ hours and allowed to cool in the furnace. On test this sample showed over 19 tons yield, 46.2 tons ultimate breaking strength, against 51.2 tons theoretical, and 19.5 per cent elongation, which indicates very good annealing.

In a second appendix the author gives details of O. F. A. Sandberg's patented method of blowing air upon hot annealed steel for the purpose of increasing its toughness, elastic limit and ultimate strength over that of normal forged steel, the use of which method was allowed free to manufacturers of forgings for the duration of the war. The method is also to be applied to steel rails to improve their wearing qualities. It involves the distribution of air at ½ to 20 lb. pressure over the pieces being treated to rapidly abstract the heat from the steel. The lower the carbon content, the more rapid should be the cooling.

The beneficial influence of this air blast upon four samples of steel is evidenced by the results given in Table 6.—EDITOR.]

TABLE 6 RESULTS IN TEMPERING BY AIR BLAST

Percentage Analysis		Before Treatment			After Treatment			Theoretical ultimate strength, tons
Carbon	Manganese	Stretch at 19 tons, in.	Ult. strength, tons	Elongation, per cent	Stretch at 19 tons, in.	Ult. strength, tons	Elongation, per cent	
				Electric Steel				
0.36	0.57	0.1	37.9	23.0	0.0	40.4	24	36
0.35	0.73	0.2	37.9	27.5	0.0	39.1	26.5	39
				Basic Steel				
0.47	0.64	0.1	37.7	27.4	0.0	41.8	25	41
0.52	0.53	0.1	39.5	23.0	0.0	46.6	20.5	42

U. S. Shipping Board Rules for the Inspection of Marine Machinery

Standardization work worthy of more than passing mention is that recently accomplished by the United States Shipping Board Emergency Fleet Corporation, the results of which are embodied in a pocket-sized volume it has issued under the title Rules and Instructions for the Inspection of Marine Machinery, Series I. These rules deal respectively with reciprocating steam engines; Diesel engines; steam turbines and reduction gears; water-tube and Scotch marine boilers; direct-acting pumps; condensing apparatus, feedwater heaters, evaporators and distillers; refrigerating machinery; propellers; auxiliary deck equipment such as capstans, winches, towing engines, etc.; and electrical equipment, including d. c. generators and searchlights.

Shortly after embarking on its huge ship-production program the Emergency Fleet Corporation found itself confronted with the imperative need for rational, precise and concordant inspection instructions covering the machinery to be installed in its vessels, not only to facilitate their rapid equipment—which the exigencies of the times demanded, but to insure that reliable machinery making for safety at sea, conforming with existing maritime regulations and whose standard parts were of interchangeable construction, would be produced.

The task of formulating such rules was accordingly placed late last fall in the hands of John A. Stevens, Standardization Engineer of the Fleet Corporation, a Vice-President of The American Society of Mechanical Engineers and Chairman of its Boiler Code Committee. Mr. Stevens at once summoned to Philadelphia some sixty of the country's prominent engineers—selected for their expert knowledge of the practical allowances, clearances, tolerances and materials that were to be provided for in the proposed instructions, and these in conjunction with the departmental engineers and chiefs of the Fleet Corporation, under his effective direction, succeeded after a few short weeks of unremitting endeavor in accomplishing the desired result. Twenty-eight of those coöperating in this important work are members of The American Society of Mechanical Engineers.

It is stated in the introductory remarks that the rules and instructions as published are not retroactive in nature and are not to be applied to machinery which has been constructed, inspected and stored; and that the whole intent of the work is to provide reasonable, sensible and commercial inspection on machinery now building or which may be built in the future.

The total number of merchant vessels under construction throughout the world (excluding the Central Powers) on December 31, 1918, according to Lloyd's Register Shipbuilding Returns, was 2189 ships of 6,921,989 gross tons, or double the largest corresponding tonnage under construction before the war.

Electric Furnaces as Applied to Steel Making

By HENRY LAWRENCE HESS,[1] BALTIMORE, MD.

THE war has wrought many remarkable changes, and when details are fully published, I believe it will be found that the electric furnace and the electric-steel industry have given a decidedly satisfactory account of themselves.

The war has undoubtedly aided the phenomenal growth of the electric furnace, but this growth has to a large extent been the result of the demand of the steel user for a quality product. The ultimate consumer in a large measure is the court of last appeal. It is the ultimate consumer who realizes that the best materials are none too good, and, taking into account the comparative cost of the steel, the cost of labor put upon it, and the tools used in fabricating, decides that it is economy to use the best steel, and that electric steel meets his requirements uniformly and satisfactorily, thus producing a demand resulting in its rapid growth.

In 1910 there were in operation in the world 114 electric furnaces. Most of these were small experimental units. In 1913 there were 140 in use. In the United States there were in operation in 1913 only 19 furnaces. In 1914, just before the war broke out, there were 213. Since then, of course, we have no reliable information as to the number of furnaces operating in Europe, but in January, 1918, there were in the United States alone, 233, 126 of which were of the Héroult type. An *Iron Age* estimate of the total furnaces in the world at the beginning of 1918, is 733. This is an expansion of over five times in four and a half years, which is truly a remarkable showing. Since January additional furnaces have been installed, bringing the total up to 265 units for the United States.

The probable tonnage of electric-furnace steel for the world is about 4,000,000 tons per year, with the United States and Canada contributing a little less than one-half of this, or about 1,800,000 tons.

Two Methods of Producing Electric Steel

In speaking of electric-furnace steel for forgings or rolling, we must bear in mind that there are two distinct types of this steel, or rather two distinct methods of producing electric steel. One is the duplex method, where molten steel, partly refined in the open hearth, is taken from this latter furnace and charged in the electric furnace for finish refining. The other is the cold-melt method where the raw materials are charged cold into the electric furnace and the entire process of melting and refining is done in that furnace. Naturally there are advocates for both methods. One manufacturer using the duplex method has referred to the cold-melt method as the complex way of making electric steel. All cold-melt makers will naturally disagree with this alleged complexity of manufacture.

The refining period is the critical period in the electric-furnace cycle and this is naturally present in both the duplex and the cold-melt methods. Any multiplication of operations adds to the possibility of added difficulties. Pre-melting in the open hearth, entails two types of equipment and specialists for both. Given competent supervision of the electric furnaces and experience in their operation, the cold-melt method appears to be the far more simple of the two. There is no comparison between the ease of control and the adaptability of the electric furnace to metallurgical manipulation and those features of the open hearth. Suffice it to say that the electric furnace is the most advanced medium for the manufacture of steel that can be placed in the hands of the metallurgist or steel manufacturer. The cold-melt method is particularly adapted to small units. Where the furnace capacity runs above 10 tons, difficulties are encountered in satisfactory melting, although furnaces of this character have been built.

Many concerns using the duplex method have done so since the electric furnace has come as a natural addition to their plants which originally contained open-hearth furnaces. A very important factor in favor of duplex electric steel is its lower cost of production. Electric power is not cheap, and melting by electricity means high conversion cost. Melting in the open hearth and refining in the electric furnace gives good steel, when handled correctly, at lower cost. There is always the possibility, however, and sometimes the tendency, to decrease the electric refining period, and the costs, and to put on the market an electrically washed steel in price competition with true electric steel. A discussion as to the metallurgical superiority of well-made steel of either class is a lengthy although interesting one, and much can be said on either side, although it is fairly agreed that the advantage of ultimate quality rests with the cold-melt method.

The Héroult Type of Furnace, Old and New

The plant that I am interested in operates two 6-ton and four 7-ton Héroult furnaces. These furnaces were chosen because there is a far greater number of them in operation in this country than of any other type, and it is, therefore, easier to obtain men familiar with the operation of the Héroult furnace. Even so, it has been decidedly difficult during the last few years to educate men in the operation of electric furnaces fast enough to keep pace with increased installations.

The 6-ton furnaces and the 7-ton units are very similar as to electrical equipment and operation. The most pronounced mechanical difference is in the method of tilting when pouring. The older 6-ton furnaces have a rounded bottom to which are attached heavy cast-steel semi-circular racks that roll forward on a horizontal rack attached to the foundation, the tilting being done by an electric motor through a series of gears, pinions and tilting arms. Tilting in this way throws the spout and the stream of metal forward as the angle of tilt increases, making necessary the following of this stream by the ladle. To eliminate this feature, the new furnaces are pivoted on trunnions, the center line of which is directly under the pouring spout. As this furnace thus tilts around the spout, the stream remains constant and it is not necessary to move the ladle during the entire pouring of the heat. The weight being carried well forward in this design, necessitates the provision of counterbalance weights to make possible the use of a small tilting motor and eliminating the likelihood of a sudden dropping back of the furnace due to shearing of a key in the tilting mechanism or other cause.

The power comes to us as 25-cycle, 3-phase, 13,200-volt current. In our stations we transform this down to 100 to 110 volts for use in the furnaces. The 6-ton furnaces are rated at 1200 kva. and the 7-ton at 1500. The power consumption runs from 650 to 900 kw. per ton, depending upon the type of steel being melted and the degree of refining necessary.

In using the electric furnace for casting purposes, acid linings are sometimes employed; but when used for the production of ingots which are later to be turned into tool or alloy steels it is almost universal practice to line electric furnaces to somewhat above the slag line, with a basic lining. Magnesite brick is used for the walls and partially for the bottom; magnesite, magdolite, dolomite, syndolag, etc., being used for bottom making and patching, according to the individual preference of the manufacturers.

The Cold-Melt Method of Producing Electric Steel

The raw materials in the cold-melt process are charged into the furnace, the electrodes being raised to permit the loading of a full charge. The doors are then closed, the hand control drawn into operation, and the electrodes, which in the 6-ton and 7-ton size Héroult furnaces are usually made of carbon and are 17 in. in diameter, are gradually fed down until contact is made with the charge. Naturally as contact is first made with the scrap and as the interstices between this material vary and change as the melting takes place, there are rapid fluctuations of power input. These power fluctuations are individual to each phase, and it is because of this very rapid change of load and the practical im-

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possibility of taking care of this mechanically, that the hand operation is often used, which operation is not as rapid as the mechanical.

As the charge begins to melt, and when the power load has settled down somewhat, the switch is thrown on to the mechanical control. This control operates through a series of switches connected to a control apparatus, which throws the power into the direct-current motors which are directly attached through a series of gears to drums which raise or lower the electrodes, decreasing or increasing the power input.

Control of temperatures and knowledge as to the temperature to be used during melting and refining is of prime importance.

FIG. 1 ELECTRIC STEEL BILLETS, EACH HAVING IDENTIFICATION MARKS

The pouring temperature must be right, for if the metal is too cold a heavy scull will be left in the ladle; if too hot, the possibility of ingot surface troubles is present, coupled with a greater likelihood of segregation.

The initial melting is done under as high power input as is possible, bearing in mind the necessity of obtaining from the furnace walls and roof the longest life economically possible when compared with the output.

Later, after the metal is melted, metallurgical reasons necessitate close control, and the temperature has quite a little to do with the removing of impurities from the steel. During the melting down, the raw materials charged have given up impurities of various sorts which are held in suspension in the molten metal. These impurities may be oxides, silicides, silicates, etc., which do not alloy with the steel but remain distinctly separate from the metal. If the molten steel were as transparent as water in a glass, we could see these foreign inclusions floating in the bath very much like small particles of dust. They are too small to rise to the surface of the bath in a short time, although their specific weight is lower than that of the steel. If, however, they could agglomerate and run together as mercury does and form large globules, then they would rise much more quickly to the surface on account of the greater buoyancy of their larger volume and would leave behind a cleaner steel. The melting temperature of most of these admixtures, however, is much higher than that of the steel, which means that they are still solid when the steel has reached a temperature sufficiently high for tapping.

In order to make the foreign inclusions coalesce and so form larger globules which will more readily free themselves, it is necessary, if possible, to liquefy them, which means a superheating of the metal. Such superheating also enables the deoxidizing agents, such as silicon, manganese, etc., to act more effectively and to make the deoxidation of the bath more complete than would be the case if the metal were more or less sluggish, or viscous. It is very necessary, however, that care be taken in this superheating, as the electric arc is the hottest-known source of heat and there is a grave possibility of burning the steel, as well as the aforementioned shortening of life of linings and roof.

Refining and slag building require that high temperatures be used, and as a rule the power is shut off entirely a few minutes before pouring in order that the bath may have a chance of settling and relieving itself of any particles of slag which may have been stirred into it.

As the melting continues, the operation becomes smoother until finally with a completely molten bath, the input of power is practically constant and is regulated according to the temperature required by the melter, to suit the stages of the refining operation. The total power input, as mentioned above, varies from 650 to 900 kw. per ton.

The charge depends upon the type of material to be made. For certain tool steels and highest-quality products it has been found best to use wash metal and ingot iron as a base. This material necessitates very little refining. For ordinary materials, because of the ease of refining in the electric furnace, it is possible to use a greater variety of raw stock. Heavy melting scrap bought on analysis limitations is used as a rule. With this charge of scrap a certain amount of limestone is added, which, upon fluxing with the molten metal, forms the basis for the slag. Through its reactions and affinities the impurities contained in the bath are eliminated to a large extent, especially phosphorus, which it is desired to reduce from the metallic charge. The character of the slag is altered to suit the reaction desired. After the action of the first slag is completed, it is removed and a second added.

During the various stages of the melting-down and refining periods, the metallic additions are made to bring the steel to the final analysis. These additions comprise, for instance, ferromanganese and ferro-silicon, which are used as deoxidizers, as well as for alloying, ferro-chrome, nickel, vanadium, tungsten, etc., etc. In addition to these ferro-titanium is sometimes used, and where deoxidization is not complete, it is sometimes customary to use a small amount of aluminum; this latter, however, is not considered best practice.

BUILDING UP CORRECT SLAGS

The building up of correct slags is quite an art and is one of the most important factors in the making of a successful electric-furnace steel. Practice varies in this to some extent. Certain concerns prefer limestone; others use slacked lime. Preference lies with some for a more liquid slag than others think best, which means a variation in the use of sand and fluorspar. A ground coke is used in the formation of the white slag, the reason being that it attacks the calcium oxide (CaO) and forms metallic calcium which in turn splits sulphides of iron and manganese (FeS and MnS) forming calcium sulphide and metallic iron or manganese (CaS and Fe or Mn). The surplus of calcium combines with the surplus carbon and forms calcium carbide—a sure sign that active desulphurizing conditions are present in the furnace. The older opinion that calcium carbide is the active agent in desulphurizing, does not hold good in actual operation, and formerly calcium carbide was added for desulphurization, neglecting the fact that calcium carbide in itself is not active in desulphurization, depnding, as it does, upon its first splitting for its action.

Naturally of prime importance is the selection of the raw materials and alloys entering into the metal and the correct calculation of the weights of these, etc., but too much consideration cannot be laid upon the necessity of careful manipulation and an ex-

Fig. 2 Electric Furnace in Operation

Fig. 3 Skimming Slag from Electric Furnace

perienced judgment in controlling the materials charged in the furnace during their melting and refining periods. The charge must be melted as rapidly as possible. Some concerns in melting down place great importance upon the necessity of not burning out the carbon below a point of approximately 0.20 content. The manganese will then, if everything has been operated carefully, be approximately around 0.30. Other concerns permit the carbon to be practically entirely reduced, a content of 0.04 or 0.05 being quite usual. It is somewhat more difficult to control the carbon and prevent this being entirely removed, but if such reduction of carbon and manganese is prevented, there is evidence that the bath has not been in an overoxidized condition, which may have been the case when the carbon has been completely removed. It should be borne in mind that when an undue amount of overoxidation has been once introduced into the molten metal, that it is practically impossible to thoroughly deoxidize the steel again with any degree of certainty. Even with the greatest care in the deoxidizing, there will always remain metallic oxides of one form or another, practically impossible to remove, and which exert a deleterious influence upon the metal produced. Fast melting with a careful supervision of the power input, proves advantageous in connection with the above practice of holding the carbon and manganese.

Heating in the Héroult Furnace

In some types of electric furnaces, the metal is subjected to heating not only from the top but from the hearth as well. In the Héroult all the heating is done from above by means of the electrodes near and above the center of the bath. This means that the heat is applied more or less locally and that there is very little tendency for circulation of the metal. In other words, the molten metal lies practically dead on the hearth. This is particularly true of that portion of the metal lying near the bottom, and for this reason, the heavier alloys have a tendency to settle, causing lack of homogeneity of the product and segregation of certain elements. This fact must be taken into account in the operation of the furnace and the metal must be put in circulation by means of systematic and vigorous stirring.

Pouring from the Furnace

In tapping the metal from the furnace, great care must be taken to see that there is as little opportunity as possible for the slag again to become mixed with the metal, and that opportunity also be given for any slag that has become mechanically mixed with the steel to rise from the metal. This is done by holding the steel in the ladle after it has been poured for as long as may be, without bringing the metal down to a temperature below that which is safe for pouring.

In ingot work practically all of the steel made is poured from "bottom-pour" ladles. Some pour directly from such ladles into the mold, others use intermediary measures such as boxes which break the head and give a more uniform and less violent stream, which tends to improve the ingot surfaces and prevent surface defects in the rolled billets and bars. Both of these methods are termed "top pouring."

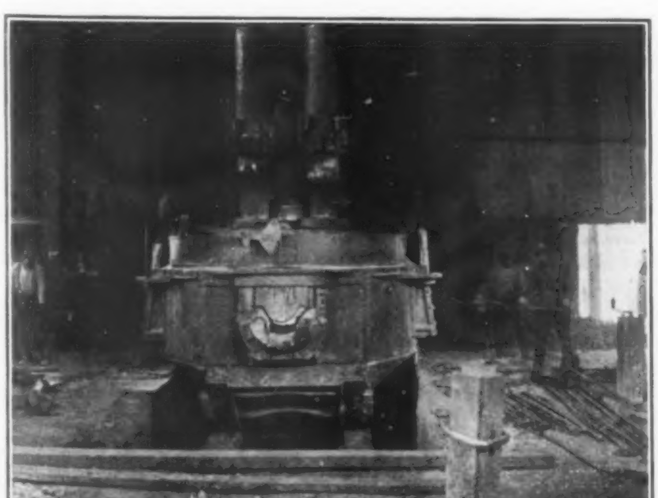

Fig. 4 Charging

Fig. 5 Stripping, Showing Refractory Top Brick

Another method is to pour down a central runner which divides at the bottom into feeders very much like the fingers of a hand, which in turn lead the metal to the bottom inlet of the ingot molds, so that as the steel is poured down the central runner, the metal rises uniformly in a set-up of molds, which usually take an entire heat.

In cooling there is a contraction of the molten metal in the molds. This contraction develops, upon solidification, along the axis of the ingot, a central cavity, largest at the top of the ingot. By carefully designing ingot molds, this tendency can be checked to some extent, and where the saving in croppage warrants such expense, as is the case with alloy and tool steels, a heat-retaining form is set upon the top of the mold, which by preventing radiation of the heat, keeps the enclosed metal hot, which metal then feeds the cavity or pipe as it develops in the ingot proper. These refractory forms are sometimes rammed up of molding sand at the plant, or are of a specially prepared fireclay material particularly adapted to this work. This latter type of hot-top brick is considered decidedly good practice, as with the use of such brick, there is practically no added possibility of introducing dirt into the steel, as is very often the case when the molded sand hot tops are used, since the faces of these sometimes spall off when subjected to the intense heat of the stream of molten metal passing by them.

ROLLING

After cooling, the ingots are removed from the molds, commonly called stripping, inspected and sent forward for further working, which may consist of forging or rolling. This paper will deal with rolling only.

Some grades of steel require special precautions, such as slow pit cooling to prevent surface cracking; or annealing to relieve internal strains and prevent checking, and for the improvement of the ingot structure. This annealing is preferably done before the ingots cool down materially.

In tonnage plants, operating on steels for rails, plates, structural shapes, etc., the ingots are charged hot as quickly as possible after pouring, into soaking pits for heating, and are then rolled or forged, as much of the initial pouring heat being retained as is feasible.

Each ingot naturally bears its identification number, which number is carried along to the final product, so that it is possible to check the bar or rod back to the heat where it was made in order that the causes of any defects may be traced.

In most alloy mills the ingots after being delivered to the rolling mill are charged into a heating furnace where they are brought up to the temperature necessary for rolling. This temperature varies according to the analysis of the material to be rolled and must be uniform throughout the ingot. If the ingot is unevenly heated, trouble will be encountered in the rolling. If very cold, the rolls may break due to their inability to stand up against the enormous strain put upon them in attempting to reduce the cold metal. If heated unequally, one side being hot and the other cold, it will be difficult to control the material in rolling, as the hot side will naturally elongate more easily than the colder and the bloom will warp and cause trouble in passing through the guides, and sometimes make it impracticable to follow through the series of passes to final reduction.

Often an ingot will look as though it were heated to the correct temperature, but the period allowed for heating may have been too short, and the core, or the center of the steel, be still cold. This will also give considerable trouble as there will be a differential flow between the outer hot layers of the material and the colder core.

It is impossible to go into great detail here as to the various processes and methods of rolling, the power required, etc., but the equipment used by the company with which I am connected may serve as an indication.

This concern has adopted as its standard for alloy and tool steels, 9-in. by 9-in. ingots weighing approximately 850 lb. This ingot is heated up in a continuous heating furnace, equipped with an electric pusher, which furnace feeds a 20-in. mill having two three-high roughing stands and one two-high finishing stand. It is driven by a 600-hp. Westinghouse motor with Westinghouse slip-type regulators, driving through a series of herringbone gears, which reduce the speed of rotation to a mill speed of 62 r.p.m.

The bar capacity of the mill is from the 9-in. ingot down through a series of Gothics, squares and diamonds, to rounds and squares 2 in. in diameter. The standard billets produced for rerolling are 4 in. These smaller billets after being rolled, are carefully inspected for surface checking, etc., pickled, chipped, reheated in another heating furnace and rolled down into the size desired on a five-stand 9-in. mill capable of giving all sizes from $1\frac{7}{8}$ in. to $\frac{3}{8}$ in. round or square. The hp. required on this smaller mill is 400. The same type of slip regulator is used for speed regulation, but, as on the smaller work, it is necessary to have some variation in speed control of the mill, and as this is not easily possible with alternating current, a heavy two-speed gear change is provided, which enables the mill to roll at 120 or 240 r.p.m.

After the bars are finish rolled, they are cut to length, inspected, straightened and shipped as finished bars, or are annealed for the refining of their grain and the softening of their structure, or heat-treated to obtain special physical characteristics.

These latter phases of the steel industry are by far the most interesting of the entire business, and most remarkable results can be obtained due to modern laboratory control and micrographical examination.

German Substitute Materials

Prior to the war by far the greater portion of raw stuffs required by Germany were imported from abroad (in round figures valued at about 10,000,000,000 marks). The blockade practically shut out foreign imports. It is thus natural that the question of substitute materials became the absorbing one in Germany. Official, industrial, and scientific Germany applied its utmost energy in attempting to solve it.

The principal efforts were made in the fiber and thread industry. The most interesting inventions in the field of textile substitutes are those procured from burning nettles, and it is believed that a valuable substitute for cotton has been found. A new chemical process for the extraction of the glutinous matter of the plant fiber has been developed and great progress has been made in extending the cultivation of burning nettles, which have been planted in great quantities.

Peat fiber belongs to the most interesting discoveries in the field of substitute textile raw stuffs. This can not, however, be practically used without mixture with other kinds of fiber. A mixture of 50 per cent peat fiber and 50 per cent wool gives what is said to be a strong and durable material that looks well and is satisfactory for men's clothing. The valuable qualities of peat fiber, however, are limited by the difficulties in procuring the peat. Only the younger moss turf can be employed in spinning. The black peat (used for burning) cannot be employed. The production from about 500,000 tons of peat amounts to about 10,000 tons of fiber; in other words, a very small amount, when the labor as well as the actual yield are both taken into account.

Great efforts have been expended, also, in attempting to find substitutes for leather and rubber.

The textile company "Barken" has succeeded in finding a substitute for "uppers," which promises to prove valuable even in peace times. Artificial rubber was produced prior to the war, but was shortly given up owing to the fact that cultivated rubber fell in price from 30 to 4 marks per kilo. When the scarcity of rubber again arose with the war, the production of synthetic rubber was again considered. Substitutes, however, had to be discovered owing to the lack of acetone and aluminum. When it was found possible to produce acetone from coal and carbide and to produce aluminum on a large scale (principally by "Grisheimer-Electron"), the production of artificial rubber could be undertaken. But the synthetic rubber is evidently merely fitted to meet a war need, for it cannot compete with the genuine article. Added to this its cost is much higher than London quotations for genuine rubber. (*Commerce Reports*, Jan. 18, 1919.)

LIBERTY ENGINE TESTS

Authentic Data on Performance Tests of the Standard High-Compression Army-Type 12-Cylinder Liberty Engine

Since the signing of the armistice a considerable amount of information has been published as to the design of the Liberty engine and its accessories. It is believed, however, that this is the first time that complete information as to the performance of the Liberty engine of the standard high-compression Army type has been published in a general engineering periodical. This information is of special interest as it shows the great power developed by this type of engine.

THE Liberty engine represents a typically American design from several points of view. The fundamental problem in developing this motor was to produce a unit which could be manufactured in quantity with such labor as was available in this country. Of course, there were at least as many skilled workmen in America as in Europe, but every skilled man was immensely necessary in a position where only skilled labor could be employed, such as tool making, ordnance production, etc., and the vast demands for aircraft motors could not be satisfied with skilled labor without disorganizing other equally important fields of production of war material.

If aircraft engines were to be built in sufficient quantities (and the original idea was to supply motors not only to America but also to the Allied forces) such motors had to be designed in such a manner as to be produced, as far as possible, by automatic machinery. This problem is actually far more difficult than would appear at first sight, because an aircraft motor has to combine unusual endurance qualifications together with light weight.

Figs. 1 to 4 show the general design of the Liberty engine. Its peculiar characteristics were such a development of parts that practically all parts could be produced on machinery of the type previously employed for mass production of automobiles.

The crankshaft is of the conventional type with seven bearings, but without counterweights. The pistons are of the die-cast aluminum-alloy type with very thick heads and tapered, increasing in thickness toward the top; a floating-type piston pin is employed. The assembly was based on the use of the individual cylinder design with steel cylinders made by a process developed by the Ford Company.

Data of several tests covering various phases of performance of Liberty engines of the standard high-compression Army type have been published in recent issues of the Bulletin[1] of the Experimental Department, Airplane Engineering Division, Bureau of Aircraft Production, War Department, from which the following abstract has been prepared by special permission.

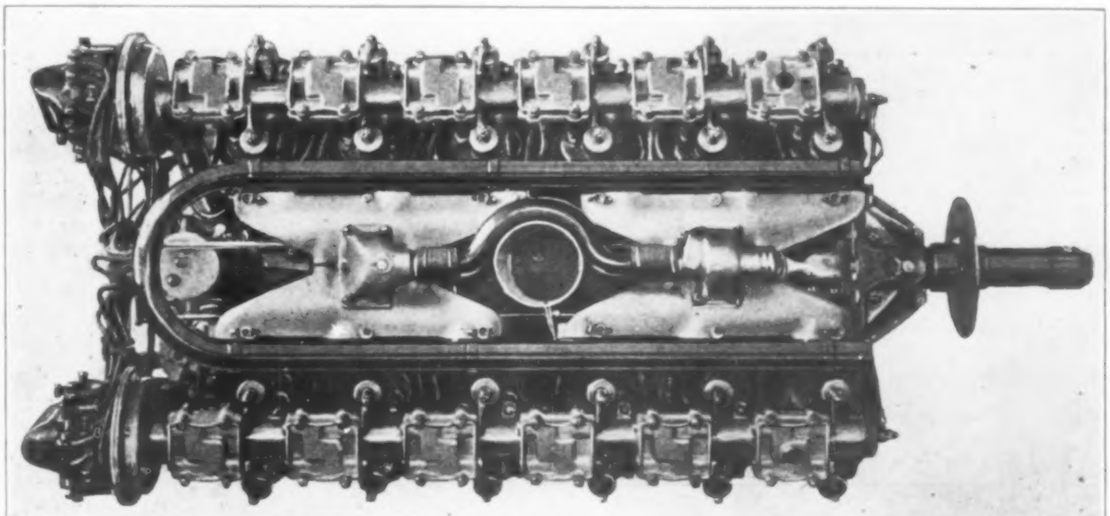

FIG. 1 TOP VIEW OF LIBERTY ENGINE

A heat-balance test on a standard high-compression Army-type 12-cylinder Liberty engine was carried out at McCook Field, Dayton, Ohio. In this test the engine was run at a constant speed of 1600 r.p.m. with wide-open throttle, developing under these conditions an average horsepower of 372.5, the tests being continued for one hour under constant conditions. These conditions involved a water-outlet temperature of 170 deg. fahr., a water-inlet temperature of 150 deg. fahr., a carburetor setting choke 36, jet 160, compensator 165 and an average speed of 1600 r.p.m.

Pennsylvania gasoline of 68 deg. Baumé gravity was used, with an average consumption of 0.492 lb. per hp-hr. The average amount of jacket water pumped per minute was 90 gal., or, roughly, 720 lb.

Based on 19,000 B.t.u. per lb. of gasoline at 100 per cent efficiency, 183 lb. of gasoline per hour will give theoretically 1365 hp., which was distributed as shown in Table 1.

TABLE 1 HEAT BALANCE OF STANDARD LIBERTY "12" ENGINE

	Hp.	Per cent of B.hp.	Per cent of total
Average brake horsepower	372	100	27.3
Average heat absorbed by jacket water	339	91	24.8
Average frictional horsepower	48	13	3.5
Remaining heat units carried off by exhaust	606	163	44.4
Total—Theoretical horsepower	1365		100.0

This table indicates that 27.3 per cent of the theoretical horsepower was converted into power by the engine, which shows a high efficiency of the water plant, especially considering the high heat losses at the exhaust. (Bulletin, June 1918, p. 77.)

A still more important test is reported in the Bulletin for July 1918. In this instance twelve engines of the standard model-A production were given identical tests in the McCook Field dynamometer laboratory, after which they were torn down and carefully inspected.

The engines were given a complete run with the standard production setting of the Zenith carburetors of 31 choke, 140 jet and 150 compensator, as well as a test with setting of 36 choke,

[1] Bulletin of the Experimental Department, Airplane Engineering Division, U. S. A., McCook Field, Dayton, Ohio, June, July and August, 1918.

165 jet and 170 compensator to determine the influence of the carburetor adjustment on the average results.

In this connection it may be stated that it has been found that the latter setting is much better than the former to such an extent that at 1800 r.p.m. with wide-open throttle the average difference in power varies in the favor of the former setting from 30 to 34 hp., the gasoline consumption being also in favor of the first setting.

Tables 2 and 3 give, respectively, the average power data and the average gasoline and oil consumption obtained from six of the twelve engines (made by the Packard Motor Car Company, of Detroit, Mich.). These data show that the engines developed power curves, of which Fig. 5 is here reproduced as representative of the set. It is also of interest as bearing out the data of Tables 2 and 3. (Bulletin, July 1918, pp. 86-104.)

A series of highly interesting tests was carried out at the laboratories of McCook Field with a special single-cylinder Liberty engine built for test purposes only. Tests carried out with this engine covered such elements of engine design and construction as pistons, piston rings, valve construction and timing, cam design, ignition timing, cylinder lubrication, spark-plug tests, etc. In such tests a single-cylinder engine is as good and sometimes better than one of the multi-cylinder type, not only because it is cheaper and easier to handle but because it affords better facilities for detecting slight variations in the character of operation.

TABLE 2 AVERAGE POWER DATA OBTAINED FROM SIX PACKARD LIBERTY "12" MODEL "A" PRODUCTION ENGINES

Engine No.		Brake Horsepower													
Packard	S. C.	1200 R.p.m.		1300 R.p.m		1400 R.p.m.		1500 R.p.m.		1600 R.p.m.		1700 R.p.m		1800 R.p.m.	
		Choke 31	Choke 36	Choke 31	Choke 36	Choke 31	Choke 36	Choke 31	Choke 36	Choke 31	Choke 36	Choke 31	Choke 36	Choke 31	Choke 36
708	18179	270	271	279	301	314	325	344	353	360	378	376	397	376	413
715	18180	281	279	306	307	331	332	355	358	373	381	383	399	385	410
716	18182	274	273	301	301	329	325	351	352	370	377	381	395	383	410
719	18183	275	278	301	306	324	334	347	354	363	384	374	403	377	420
720	18184	268	275	290	301	320	328	343	351	357	378	366	396	366	412
732	18181	279	271	305	297	329	324	347	355	368	373	380	392	375	407
Averages.........		274	275	300	302	325	328	348	356	365	379	377	397	378	412

TABLE 3 AVERAGE GASOLINE AND OIL CONSUMPTION OBTAINED FROM SIX PACKARD LIBERTY "12" MODEL "A" PRODUCTION ENGINES

Engine No.		Gasoline Economy at 1600 R.p.m.						Oil Economy at 1600 R.p.m.					
Packard	S. C.	36—165—170 Average Hp., 378			31—140—150 Average Hp., 367			36—165—170 Average Hp., 378			31—140—150 Average Hp., 367		
		Lb./hr.	Gal./hr.	Lb./hp-hr.	Lb./hr.	Gal./hr.	Lb./hp-hr.	Lb./hr.	Gal./hr.	Lb./hp-hr.	Lb./hr.	Gal./hr.	Lb./hp-hr.
708	18179	200.0	32.0	0.530	194.5	31.1	0.535	14.1	1.95	0.0370	19.4	2.67	0.0532
715	18180	199.0	31.8	0.526	195.0	31.2	0.520	11.5	1.59	0.0304	13.0	1.79	0.0350
716	18182	199.0	31.8	0.527	198.5	31.8	0.541	13.5	1.88	0.0360	15.8	2.17	0.0430
719	18183	192.5	30.8	0.502	190.0	30.4	0.519	10.7	1.48	0.0280	12.6	1.74	0.0350
720	18184	192.5	30.8	0.510	193.0	30.9	0.539	11.3	1.56	0.0290	10.3	1.42	0.0288
732	18181	193.0	30.9	0.533	195.5	31.3	0.525	11.8	1.63	0.0320	9.6	1.31	0.0256
Averages................		196.0	31.3	0.521	194.4	31.1	0.530	12.2	1.68	0.0321	13.6	1.85	0.0351

on an average from about 275 hp. at 1200 r.p.m. to 412 hp. at 1800 r.p.m., which is a very good output considering the weight of the engine.

Spark plugs gave considerable trouble throughout the test. It was noted that this trouble would diminish greatly as the test proceeded, showing that a certain number of plugs will fail after a very short time in service, frequently as little as 5 min. This generally was noted by the porcelain chipping off at the outside of the plug, thereby allowing the plug to jump from the center electrode to the outside shell. There is evidently a strain set up in the manufacture of some of these plugs, so that they are unable to withstand the heat or vibration of the engine for an appreciable time.

A suggestion is made in the report that consideration be given to some method of subjecting the plugs to an operating test at the manufacturer's plant which will in some way simulate actual operating conditions, thus enabling the manufacturer to eliminate those plugs which now give service only for a few minutes. At the same time it should be borne in mind that dynamometer testing conditions are somewhat more severe on spark plugs than are actual flying conditions.

Curves for fuel and oil economy are given as well as average

For these tests a special engine was constructed, in reality a standard Liberty engine of one cylinder instead of twelve: the cylinder itself, valves, valve springs, piston, piston pin and rings, etc., being exactly the same as those used in the 12-cylinder engine, while the crankcase, crankshaft and camshaft were different. Care was taken to arrange the installation in such a manner that the design of the engine would not differ from that of the 12-cylinder engine to such an extent that it might affect the results. For all tests a special carburetor was used—diagrammatically shown in the original article. The ignition for this engine was identical with that of the Liberty-12, a special timing mechanism being used.

Data of tests are summarized in a table, each test covering one or more variables as the case may be. It might be stated, in this connection, that the tests made with the single-cylinder engine to obtain data for the improvement of the design of the 12-cylinder unit are of particular interest as a good lesson on methods in engine designing. While not every plant can afford such a thorough investigation of its products, it is certainly an excellent way to secure extremely valuable results wherever it can be done.

The tests have brought out several factors of considerable importance. The first variable which was tested was that of the employment of a horizontal intake pipe that was not water-jacketed. Five series of tests were run; the first without any intake pipe at all; then with different lengths of pipe, such as 6-in., 10-in., 14-in., and 18-in. It was found that the results were materially affected by the carburetor choke size and were non-uniform for different speeds. Thus, with 1⅛ in. choke, the highest horsepower with the 14-in. intake was obtained at 1600 r.p.m., equaling that with the 10-in. manifold pipe at 2000 r.p.m. With the same choke and an 18-in. intake pipe the highest output was secured at 1600 r.p.m. (29.6 b.hp.), but at 2000 r.p.m. this fell to 26.8 b.hp., which would indicate that with the increased suction there was a throttling action at the choke or increased turbulence in the intake pipe. This agrees well with the third set tests with 1⅝ in. choke, where the brake horsepower increased fairly uniformly with the engine speed in all cases and did not appear to be materially affected by the difference in length of intake from 14 to 18 in., though with the short intake, 10 in., it was slightly lower (41.0 b.hp. as against 42.0 and 42.8, respectively).

At first the improvement realized with the 18-in. intake pipe, which size proved superior to any of the others, was ascribed solely to the "battering-ram" characteristics acquired by the column of mixture in the intake header. The particles, having some inertia, tend to build up a pressure against the carbureter side of the inlet valve while the valve is closed, which pressure is available on the next suction stroke to assist in forcing in the new charge. That there is considerable pressure generated in this manner is proven by the fact that the gasoline vapor is blown back out of the carbureter choke when the engine is running. Later experiments proved, however, that the battering-ram feature plays a minor part in the success of the long intake header. Tests made later with a water-jacketed manifold to the same length proved that it was the reduction of temperature in the long intake pipe which accounted for most of the improvement in the tests which were run without any water jacket around the intake header. It was found that the mixture when not heated in the intake pipe reaches a minimum temperature of about 40 deg. fahr. below the carbureter intake air temperature.

Fig. 7 shows the 18-in. horizontal intake manifold fitted with a water jacket so that all the cooling water passing through the cylinder jacket also passes through the water jacket around the intake header after leaving the cylinder. The curves in Fig. 9 show the effect on the horsepower output of the use of this water-jacketed intake, and also the resulting increase in temperature of the gases in the intake manifold. The engine outlet water temperature was controlled and power readings were taken over a range of various temperatures of the cooling water from 90 deg. to 200 deg. fahr. at a constant engine speed. The drop in power with the increase in water temperature, which, of course, increased the temperature of the gases in the inlet manifold, was plotted together with the actual changes in the inlet gas temperatures.

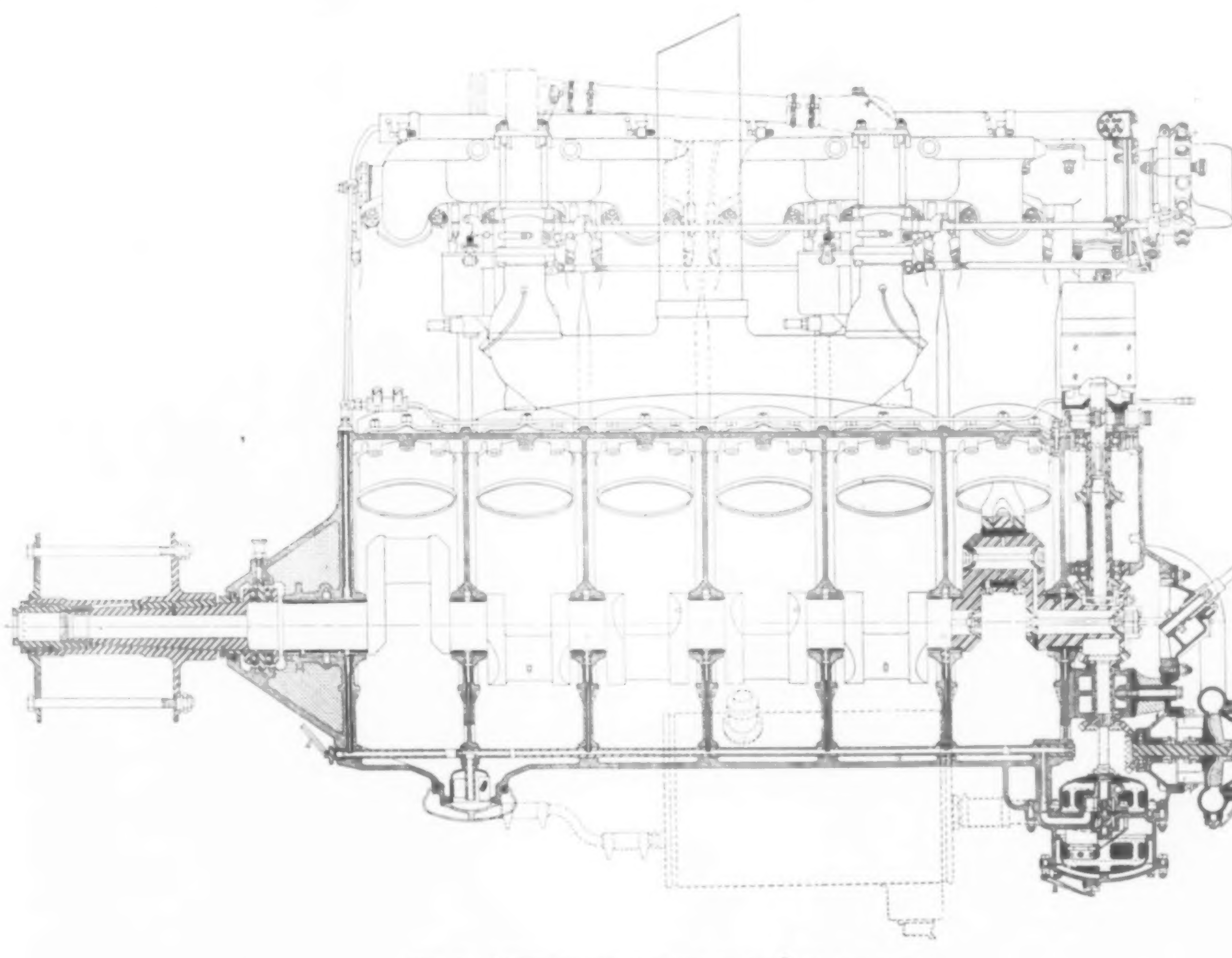

FIG. 2 LONGITUDINAL SECTION OF LIBERTY ENGINE

The curves in Fig. 8 prove conclusively that the power output is largely increased with the cold manifold, and show that this is one of the simplest means of obtaining supercharge. The amount of supercharge may be easily as high as 10 per cent, figuring an increase of volume of 0.2 per cent for each 1 deg. fahr., based on 100 per cent volume at 32 deg. fahr. In other words, with the temperature in the inlet pipe at 32 deg. fahr., 10 per cent more mixture can be had at atmospheric pressure than if the temperature in the intake pipe were 82 deg. fahr.

It is believed that certain difficulties will arise if the intake temperatures are lowered too much. It is reasonable to suppose

that the distribution of a uniform mixture to the various cylinders will become more and more difficult as the temperatures are lowered, due to the heavy particles of fuel carried along in a liquid state having considerable inertia. No doubt there would be a tendency for these particles to accumulate in larger percentages in those cylinders which from the nature of the manifold are reached by an easier or straighter path from the carbureter.

It would seem that the so-called "hot-spot" manifold would furnish a solution of this difficulty. This type is so designed that only a portion of it is heated, that being the section in which the

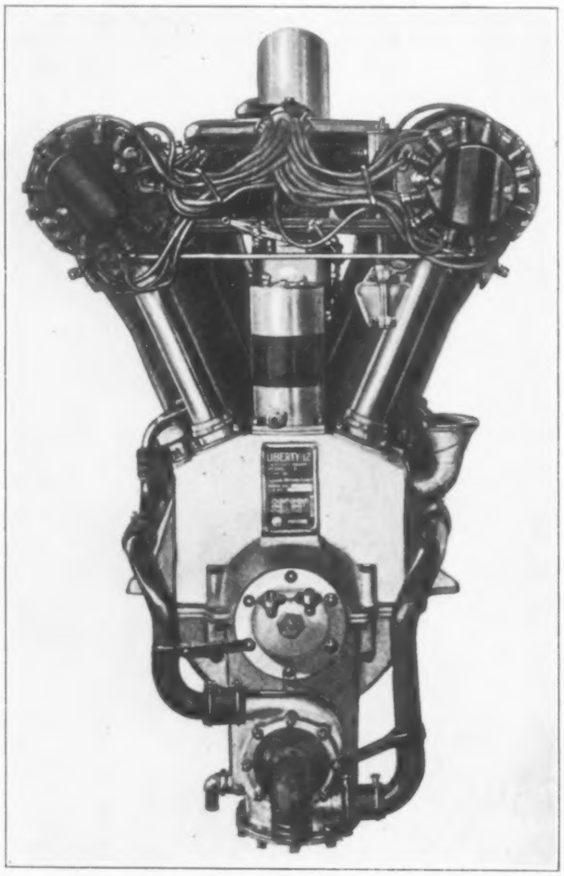

Fig. 3 Distributor End of Liberty Engine

liquid particles carried along by the gas are most likely to come in contact with the inner walls of the manifold.

It is noteworthy that both the Mercedes and the Benz engines have long manifolds which are covered with an insulating wrapping. Recent tests of a 260-hp. Mercedes so equipped have shown perfect distribution of the intake gases, proving that by proper design of the intake manifold distribution difficulties with cold mixtures can be practically eliminated.

The question of fuel economy also comes up in this connection, although this evidently is largely a matter of distribution. There are indications, however, that a slight sacrifice of economy may accompany a large increase of power, due to cold intake gases.

Obviously there is little or no likelihood of using a straight 18-in. horizontal intake pipe on a V-type engine such as the Liberty-12. In order, therefore, to simulate as much as possible the construction form which would exist in such an engine, a crooked vertical intake pipe was made up as shown in Fig. 6.

The results of numerous tests with the crooked intake pipe prove that its action is on the average quite similar to that of the straight pipe. Comparisons of tests 8 with 16, 20 with 13, 12 with 15, and 24 with 36 (see Table 1, August Bulletin) show that in one case one pipe is somewhat superior and in another case the other pipe is slightly better. It is apparent, therefore, that the cooling action of the one pipe is about the same as the other, and whatever difference there may be in the battering-ram action between the two pipes does not materially affect the result.

There was very little spark-plug trouble throughout the single-cylinder engine tests, which would seem to indicate that the raising of the brake mean effective pressure in the 12-cylinder Liberty engine will not necessarily bring about an increase in spark-plug defects.

With the best combination of features on the single-cylinder engine it was found that at 1800 r.p.m. it developed 39 hp. Multiplying this by 12 would give 468 hp. for a similarly fitted 12-cylinder engine. Theoretically, the power output of the 12-cylinder engine should be about 25 hp. more than this, due to the fact that the friction losses of the 12-cylinder engine would not be 12 times as great as in the single-cylinder engine.

From results of these tests it would appear that a 12-cylinder engine can be advantageously fitted with pistons of a 6:1 compression ratio. Such a compression ratio in combination with the other features appeared also desirable, as it was believed that it would give a greater ceiling for the plane and greater speed at high altitudes. These tests further indicated that it might become desirable to use a reduction gear between the engine and propeller, thus enabling the engine to develop its greatest power at the highest practicable running speed while still utilizing more efficient propeller design. This has been ultimately adapted with the so-called Liberty epicyclic reduction gear.

The next tests were designed to determine the results of operat-

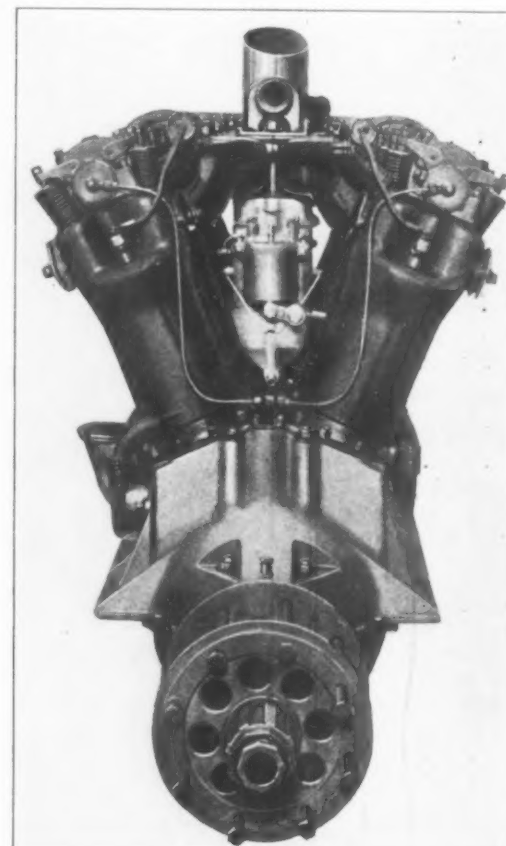

Fig. 4 Propeller End of Liberty Engine

ing two production motors in the air for long periods without overhauling. In this instance two standard-production Liberty engines were given flight tests under service conditions as nearly as possible. One of the test engines (801) originally ran 60 hr. and the other (719) was operated 75 hr. Both were then torn down for examination, when it was found that they were in such excellent condition that it was decided to reassemble them without any replacements of parts and give them a much longer test. The first engine was run an additional period of 100 hr. and the other 85 hr., making a total of 160 hr. for each.

When these engines were torn down after the 160-hr. runs they were still in fairly good running condition, neither having shown

any signs of imminent failure. On the other hand, it was apparent that neither engine would have run very much longer.

In all these tests the engines were mounted in Curtiss R-4 planes, which are somewhat slower and heavier than the DeHaviland-4, but similar enough to the DeHaviland to warrant the belief that both the horsepower developed and the fuel consumed

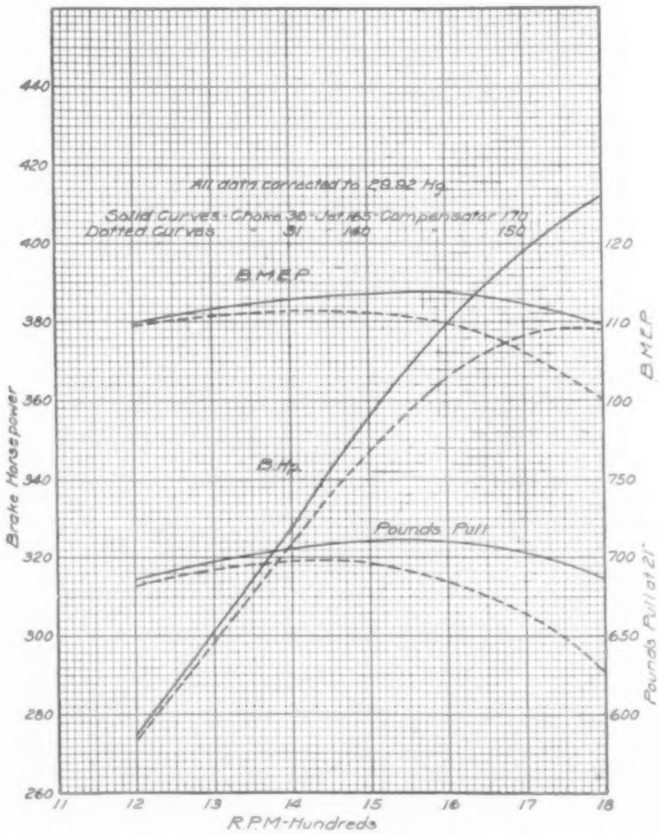

Fig. 5 Curves of Fuel and Oil Economy and of Average Power of Liberty Engine

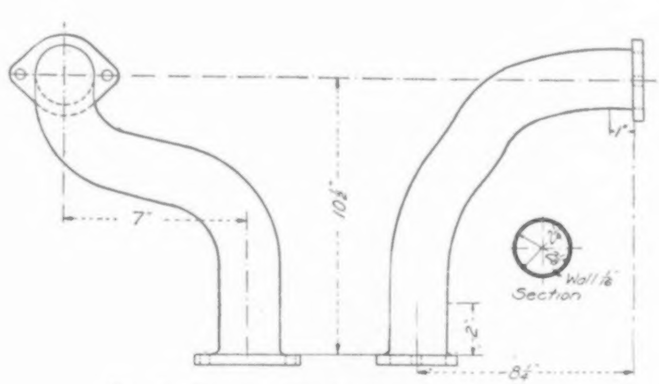

Fig. 6 Crooked Intake Pipe Used for Tests

would be nearly the same in both cases. The planes did not carry full loads such as would be carried, for instance, in bombing expeditions at the front, but the results of the tests were considered to be sufficiently representative to allow computing quite closely the probable flight duration of the Liberty engine in different planes and under various service loads.

Castor oil was used exclusively in one engine and Wolf's Head No. 8 mineral oil in the other. Judging from the condition of the two engines at the end of the runs, castor oil gave slightly better results than the mineral oil, although spark-plug troubles were more frequent in the engine using it.

While both engines unquestionably required overhauling after the 160 hr. of operations in the air, most of the parts were still in fine condition, the crankshaft and connecting-rod bearings being practically the only parts badly worn.

The spark plugs gave the worst trouble, only minor replacements being needed otherwise. It is of interest to note, as regards the condition of the cylinders, that on final inspection after the 160-hr. runs the bores were still in excellent condition and showed a maximum out of round on one engine of but 0.0015 in. and on the other of but 0.002 in. Very little carbon was found on the head.

The general impression is that such troubles as were experienced during these tests were due almost entirely to workmanship,

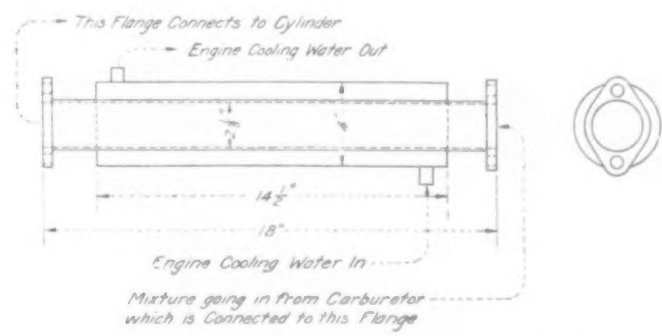

Fig. 7 Diagram of 18-in. Water-Jacketed Intake

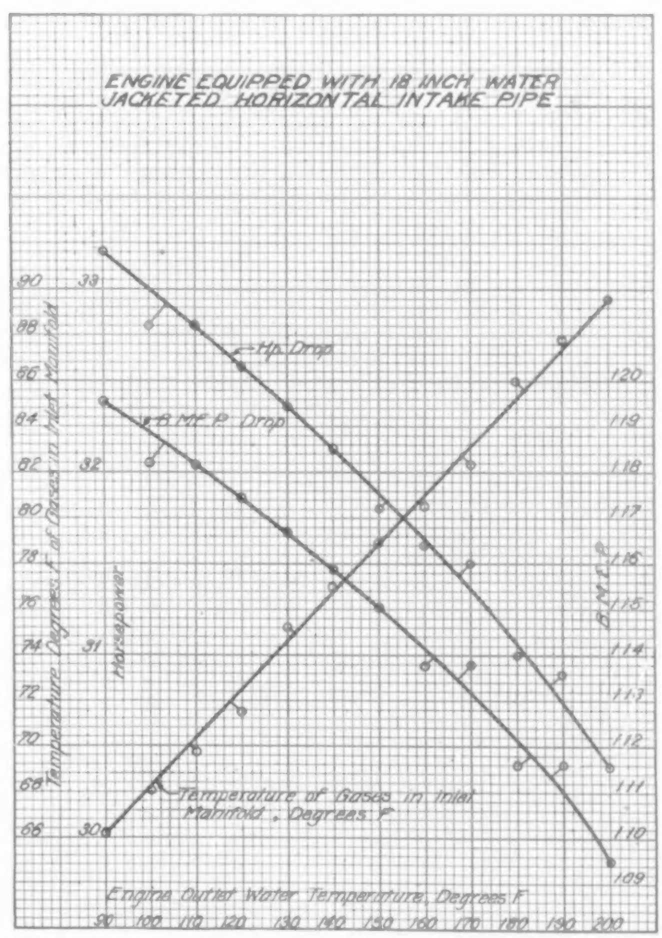

Fig. 8 Curves Showing Drop in Horsepower with Increase of Temperature of Intake Gas

materials and the personal element that enters into the manufacture and assembly, but not to faults in design.

These tests have brought out conclusively that 125 to 150 hr. is not too much to expect of the Liberty engine without fatigue, which is a very good performance compared with other engines now in operation.

(Concluded on page 295)

BABBITT AND OTHER BEARING METALS

Compositions Recommended by the Committee of the Manufacturers' War Service Association

At the request of the Assistant Chief in Charge of Tin, War Industries Board, the War Service Association of Manufacturers of Solder and Bearing Metals appointed a special committee to study the report of the United States Bureau of Standards to the Conservation Division of the War Industries Board, the suggestions for the conservation of tin which the War Industries Board proposed in a circular letter to users of babbitt and other bearing metals, and other similar documents.

Pending the termination of the researches which are now being undertaken by the Sub-Committee on Bearing Metals of The American Society of Mechanical Engineers, as reported in the January issue of Mechanical Engineering, p. 71, it will be of interest in the meantime to present a brief abstract of the recommendations offered by this special committee of the Association of Manufacturers of Solder and Bearing Metals as a result of their examination of the aforesaid documents and a general survey of the available literature and of the experience of manufacturers and users of bearing metals.

The committee favors the adoption of all the alloys listed by the American Society for Testing Materials in Their Tentative Specifications for White Metal Bearing Alloys, Serial Designation B-23-18-T (See Table 1), subject to the following modifications and additions:

a To increase the allowable maximum for lead in alloys Nos. 1, 2 and 3, providing the Bureau of Standards after complete investigation of the matter of lead content feels that it is safe to do so.

b To increase the arsenic maximum of alloys Nos. 11 and 12 (see Nos. 14 and 15 in Table 2) to 1 per cent.

c Include the following alloys and designate them numerically Nos. 6, 7 and 8 and increase the numerical sequence of alloys Nos. 6 to 12 of the A. S. T. M. accordingly:

	Alloy No. 6	Alloy No. 7	Alloy No. 8
Tin, per cent	61½	45	30½
Antimony, per cent	10½	7½	8½
Copper, per cent	3	1½	1
Lead, per cent	25	46	60

d Include under the numerical designation Nos. 16 and 17 the lead alloys recommended by the Bureau of Standards in their suggestions for the conservation of tin. (See Table 2.)

Table 1 therefore is modified as represented in Table 2, which shows the composition of the alloys as finally recommended.

The committee believes that the 17 alloys in Table 2 will cover in a very comprehensive manner the number needed to meet every service requirement.

TABLE 1 COMPOSITIONS OF A. S. T. M. TENTATIVE STANDARD ALLOYS

Alloy, Grade No.	Tin, per cent	Antimony, per cent	Lead, per cent	Copper, per cent	Iron, max., per cent	Arsenic, max., per cent
1	91	4½	0.35*a*	4½	0.08	0.10
2	89	7½	0.35*a*	3½	0.08	0.10
3	83⅓	8⅓	0.35*a*	8⅓	0.08	0.10
4	75	12	10	3	0.08	0.15
5	65	15	18	2	0.08	0.15
6	20	15	63½	1½	0.08	0.15
7	10	15	75	0.50*a*	....	0.20
8	5	15	80	0.50*a*	....	0.20
9	5	10	85	0.50*a*	....	0.20
10	2	15	83	0.50*a*	....	0.20
11	..	15	85	0.50*a*	....	0.25
12	..	10	90	0.50*a*	....	0.25

a Maximum.

TABLE 2 COMPOSITIONS RECOMMENDED BY COMMITTEE OF WAR SERVICE ASSOCIATION OF MANUFACTURERS OF SOLDER AND BEARING METALS

Alloy, Grade No.	Tin, per cent	Antimony, per cent	Lead, per cent	Copper, per cent	Iron, max., per cent	Arsenic, max., per cent
1	91	4½	*b*	4½	0.08	0.10
2	89	7½	*b*	3½	0.08	0.10
3	83⅓	8⅓	*b*	8⅓	0.08	0.10
4	75	12	10	3	0.08	0.15
5	65	15	18	2	0.08	0.15
6	61½	10½	25	3	0.08	0.15
7	45	7½	46	1½	0.08	0.15
8	30½	8½	60	1	0.08	0.15
9	20	15	63½	1½	0.08	0.15
10	10	15	75	0.50*a*	....	0.20
11	5	15	80	0.50*a*	....	0.20
12	5	10	85	0.50*a*	....	0.20
13	2	15	83	0.50*a*	....	0.20
14	..	15	85	0.50*a*	....	1.00
15	..	10	90	0.50*a*	....	1.00
16	..	..	98*c*	....	....	....
17	..	..	98*d*	....	....	....

a Maximum. *b* See recommendation (*a*) of committee. *c* Approximate: balance alkali metals. *d* Approximate: balance alkaline earth metals.

With reference to the conservation of tin, the committee proposes the following suggestions:

a For resistance to extreme pressures and impacts, when the design of the bearing is such that a heavy liner is used—Alloy No. 3.

b For supporting smaller loads, or resisting smaller impacts, and when thinner liners are used—Alloy No. 2.

c For the thinnest liners, particularly those attached to bronze or steel backs by the soldering process, and under conditions where the shocks are not so severe as to require the use of harder alloys, either Alloys Nos. 6, 7 or 8, depending on which exhibits the best physical properties (these to be determined by the Bureau of Standards).

d For all classes of service other than *a*, *b*, *c*, *e* or *f*—Alloy No. 10, which is the most satisfactory lead-base babbitt containing tin and antimony.

e For service under low pressures, and without impact, operated at fairly low speeds—Alloy No. 14.

f Alloys Nos. 16 and 17 for the special classes of service for which they may be found suited after sufficient service experience.

Further details are now available regarding the record flight of a U. S. Navy seaplane with 50 passengers at Rockaway on November 27. The machine was an N. C. 1 of the flying boat type, the wings having a span of 126 ft., fitted with three low-compression Liberty engines, each of 385 hp. The normal speed of the machine is 80 miles per hour, but with 50 passengers this was reduced to 72 miles per hour. According to the report of the Aero Club of America, the machine left the water within 1000 ft. at a speed of 45 knots, and rose to a height of 35 ft. It is stated that the machine can climb 2000 ft. in ten minutes.

To overcome a threatened power shortage and to provide power for the rapidly increasing industrial activities in the San Francisco Bay region, the California-Oregon Power Company, the Northern California Power Company, and the Pacific Gas and Electric Company have consolidated, and electric power is now being transmitted continuously over a distance of 300 miles. The surplus power developed in the northern section of the state is thus made available in the industrial district. According to the State Railroad Commission, it is expected the 60,000,000 kw-hr. of energy will be brought to the Bay district annually, with a saving of 20,000 barrels of oil which is now used for the generation of power.

The Loomis Cooling System for Aircraft

A System Embodying a Nose Radiator, an Adjustable Booster and a New Form of Expansion Tank with Positive Ejection

Two features new to airplane cooling systems and which are adaptable to any airplane carrying a water-cooled engine have been developed at McCook Field, Dayton, Ohio, and incorporated in the USD-9A day bombing machine. Particulars of these features, comprising what is known as the Loomis cooling system, appeared in a War Department publication of recent date, which is herewith abstracted by special permission.

THE Loomis cooling system for aircraft was developed at McCook Field, Dayton, Ohio, and first applied to the USD-9A plane. Particulars of this system have been given in a recent issue of the Bulletin[1] of the Experimental Department, Airplane Engineering Division, Bureau of Aircraft Production, War Department, from which the following information has been abstracted by special permission.

The two new features in the Loomis system are an expansion tank that surrounds the core and is an integral part of the nose radiator, thus taking the place of the shell ordinarily used; and an injector in the water connection between the main and booster radiators, which draws water through a nozzle outlet from the bottom of the expansion tank and injects it into the return pipe, thus keeping constant the volume of water in the circulating system.

It is claimed that through these features the loss of water due to steaming or air pockets is minimized and excessive depression in the pump intake is prevented, making possible a much faster water circulation and, therefore, increased cooling efficiency without danger of cavitation in the pump or the drawing in of air around the hose connections on the suction side.

Water from the cylinder jackets enters the upper well of the nose-radiator core in the usual manner, and nearly all of it works down through the core to the bottom of the well, and then through the venturi outlet to the return pipe leading to the booster radiator and the pump. Owing to the action of the venturi, the head of water in the nose-radiator core and the type of pump impeller used, pressure is built up on the intake side of the pump.

A small quantity of water from the upper header of the radiator core normally overflows through holes in the top of the upper well into the expansion tank (Fig. 1) above, and then flows downward in this chamber by gravity. The lowest part of the expansion tank, underneath the lower header of the radiator core, has an outlet nozzle which opens into the throat of, and is concentric with, the venturi outlet from the lower tank. The top of the expansion tank is open to the atmosphere through the vent pipe terminating in the radiator filler neck, so that constant atmospheric pressure is maintained on the water in the expansion chamber, in order that it may be drawn into the return pipe through the action of the venturi at the nozzle.

The auxiliary radiator is located in the water return line between the nose unit and the pump, so that all water from the main radiator passes successively through the venturi and the booster or auxiliary radiator, from top to bottom, before reaching the pump. Fig. 2 shows the connection between the main radiator, injector and booster.

Running entirely around the outside of the nose-radiator core and its upper and lower headers is a separate compartment, $\frac{7}{8}$ in. wide, and of the same depth as the core, which acts as an expansion chamber for the cooling system. The only communications between this tank and the upper well of the radiator core are three [illegible]-in. vent holes. As shown in Fig. 3, the bottom of the well of the core communicates only indirectly with the bottom of the expansion tank through the venturi and nozzle. The injector consists of a $1\frac{1}{16}$-in. diameter venturi outlet from the lower tank or well of the radiator core, with the $\frac{1}{2}$-in. diameter nozzle of the outlet pipe from the bottom of the expansion tank projecting into the throat. The general construction of the outlet is shown in Fig. 3.

Mounted in a vertical rack to the rear of the engine and transversely to the fuselage is the adjustable booster radiator, which is connected in series with the nose unit. The auxiliary radiator may be lowered to project $9\frac{1}{8}$ in. below the bottom cowl of the fuselage, or drawn up into the body until only the edge of the lower tank is exposed.

When the auxiliary unit is lowered to its extreme position, practically its entire surface is exposed to the air stream under the fuselage.

In its upper position this radiator has very little cooling effect, as it is then almost entirely enclosed in the fuselage and only a small amount of air can circulate through it. Most of the air going through the nose radiator is discharged through the louvers in the engine cowls forward of the booster.

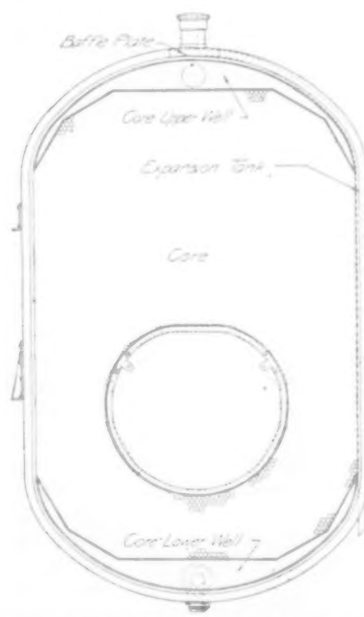

FIG. 1 DIAGRAM SHOWING THE EXPANSION TANK AROUND RADIATOR CORE AS USED ON THE USD-9A PLANE

The auxiliary cooling unit is raised or lowered by a handwheel on the right side of the pilot's cockpit, which is connected by short lengths of chain and intervening wires with a pinion meshing with a rack attached to the upper part of the auxiliary radiator. The pilot can set the booster unit to project any desired distance below the under side of the fuselage, within the limits provided, in order to obtain the exact amount of cooling capacity needed under different conditions.

While both the nose-radiator shutters and the adjustable-booster unit are provided for the same purpose, that is, to increase or decrease the cooling capacity of the system as a whole, it is the practice to open the shutters first and to lower the auxiliary radiator later, to provide still greater cooling capacity, and vice versa, thereby keeping the parasite resistance down to a minimum.

A series of test flights was made at McCook Field with two DeHaviland-4 planes to determine the relative efficiency of the new cooling system designed for the USD-9A in comparison with other comparable types. Owing to the similarity in size between the DeHaviland-4 and the USD-9A, and to the fact that both planes carry standard Liberty-12 engines, it was considered that the tests would give a good indication of the performance to be expected of the new system in the USD-9A.

The other radiators tested on the same planes for comparison were the Wolverhampton, used in the British DeHaviland-4, and

[1] Bulletin of the Experimental Department, Airplane Engineering Division, U. S. A., McCook Field, Dayton, Ohio, vol. 2, no. 2, November 1918, pp. 61-68. 7 figs.

rated as adequate for a 350-hp. engine, a special American Monogram radiator made by the A-Z Co., and two sample Mayo radiators with ribbon-type cores. These last two were especially designed for the American DeHaviland-4 with Liberty engine. The units tested were near enough alike in general features to offer a fair basis of comparison for the USD-9A system.

By means of preliminary tests a type of pump impeller was selected which was found to be well suited to the new system which produces a certain amount of pressure on the intake side of the pump due to the action of the injector. For use with the Wolverhampton radiator, it was necessary in order to prevent excessive suction to cut down the standard straight-blade impeller with the DeHaviland-4 to 3¼ in. diameter. The regular pump impeller was used without alteration with the other radiators tested. The original report gives the curves of pressure on pump inlet both developed by the straight-bladed pump impeller cut down to 3¼ in. diameter for the English radiator and by the USD-9A radiator with curved-blade impeller used with the Loomis system.

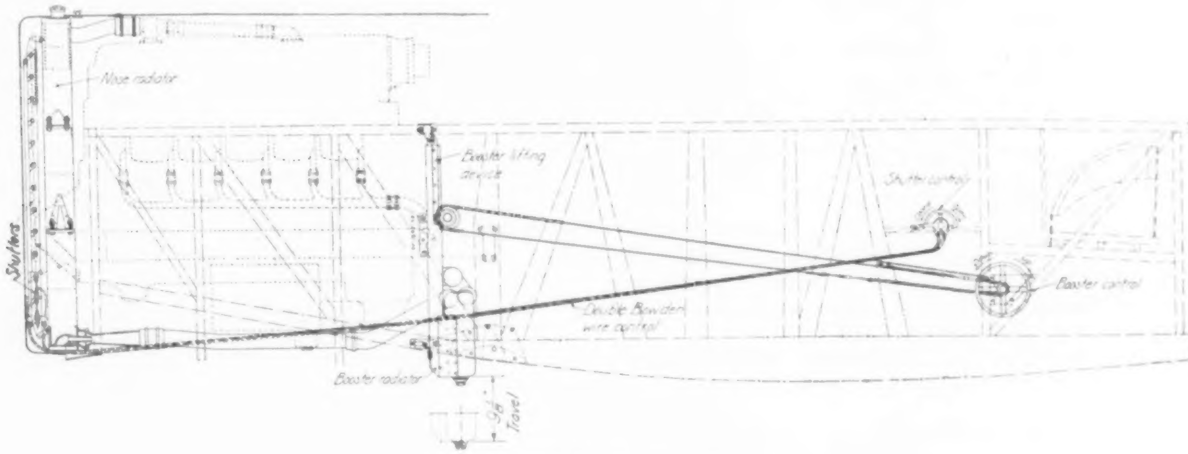

FIG. 2 USD-9A COOLING SYSTEM

Various precautions described in the original report were taken to insure the correctness and comparability of results obtained with various radiators.

One of the interesting features developed in the tests is that the greatest difference between air temperature and water outlet temperature was found at altitudes between 3000 and 5000 ft., which tends to prove the assertion that a radiator which is adequate up to 3000 ft. under rapid-climb conditions will probably provide sufficient cooling capacity for all purposes.

The following conclusions are made in the report, which also gives the main data secured in tabular form.

Taken on the whole, the USD-9A radiator tests yielded quite good figures for efficiency, which can be depended upon as reliable. The efficiency values obtained in the various trials of this system were:

With no engine top cowl, bottom cowl with extra louvers—91 per cent.

With extra louvers in top and bottom engine cowls, average of two tests—88.8 per cent.

With standard top cowl and no louvers in bottom cowl, average of three tests—87.8 per cent.

These figures indicate that although something is gained by extra louvers in the cowling, still the engine and its front bearer in the USD-9A obstruct the flow of air through the nose radiator to such an extent that the only great gain to be obtained would be by using wide lateral openings in front of these two units to exhaust the air passing through the nose radiator.

Steaming falsifies the apparent efficiency of a radiator, as it reduces the amount of cooling required to be done by the cooling system. A steam calorimeter in the overflow tube would be necessary for accurate corrections.

The only comparisons possible with the other radiators tested must be based on the figures obtained during those trials where no steaming of the other units took place. The comparative results obtained in such tests, with corresponding figures for the USD-9A system, are given in Table 1.

The addition of engine top cowling must produce less effect on the new cooling system than on the other two radiators mentioned in Table 1, for the reason that part of the total cooling surface of the new system, represented by the booster radiator, is independent of all cowling above or below the engine, provided, of course, the lower cowling does not obstruct the auxiliary unit when in its lowest position. The addition of shutters on the nose radiator also produces less effect on the USD-9A cooling system than on the others, and for the same reason.

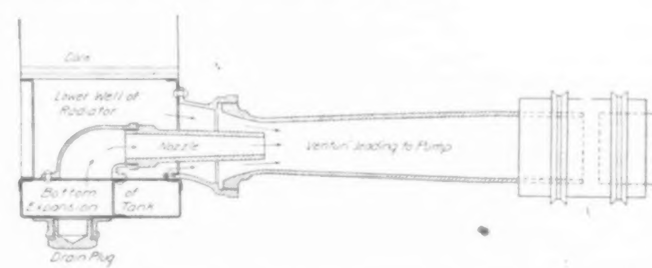

FIG. 3 INJECTOR DEVICE AT BOTTOM OF NOSE RADIATOR

With this radiation system any reasonable increase in cooling capacity can be obtained by adding to the height of the auxiliary radiator. It is quite probable, however, that the present amount of auxiliary radiation is sufficient in view of the fact that very little steaming was encountered even under the severe conditions of the tests. Under ordinary conditions the high-compression Liberty engine is not intended to be run at full throttle near the ground, as was done in these tests.

TABLE 1 COMPARATIVE EFFICIENCY OF RADIATORS

Radiator	Efficiency, per cent	Cooling surface, sq. ft.	Weight full, lb.
Monogram	76.75	202	176.5
Wolverhampton	82.5	246	142
USD-9A	91	219	204.5

The United States Navy Department has successfully carried out the experiment of launching an airplane from a dirigible balloon. The airplane was attached by a 100-ft. cable to the dirigible; both rose to about 3,000 ft. and then the airplane was released; after diving about 1,000 ft. it obtained sufficient speed to continue its usual flight.

STRESSES IN WIRE ROPE

Development of a New Formula for the Determination of Bending Stresses

By SHORTRIDGE HARDESTY,[1] KANSAS CITY, MO.

At the December 1918 Annual Meeting of the Society a valuable paper on the Determination of Stresses in Wire Rope as Applied to Modern Engineering Problems was presented by James F. Howe, Wire Rope Engineer of the American Steel and Wire Company, Worcester, Mass. This paper has drawn out the accompanying contribution by Mr. Hardesty. A very full review of Mr. Howe's paper was given in The Journal for December 1918, p. 1016.

THE writer has been deeply interested for some time in the subject of wire-rope stresses, upon which Mr. Howe has written, and submits the following notes on a few points to which he has given considerable study.

Mr. Howe brings out the point that while the modulus of elasticity in tension of the material in the wires is 27,500,000, the corresponding value for an entire rope of standard 6 x 19 construction is about 12,000,000; or, in other words, that the rope stretches about 2.3 times as much as would one made of straight wires. Different investigators in the past have found values of this function ranging from 12,000,000 to 17,000,000. For any given rope its value depends somewhat upon the age and condition of the rope. For a new, well-lubricated rope, 12,000,000 is correct; while in an older rope, in which the hemp center has been compressed and has become hardened, a larger value will be found. If, however, the rope is subjected to bending over small sheaves, the hemp center will be continually worked and stretched, and the rise in the value of the modulus of elasticity will be much smaller.

It is not difficult to explain why the rope stretches more than would a bundle of straight wires. A 6 x 19 rope is composed essentially of 114 spiral springs. Under tension these springs stretch out, the diameters of the helices reducing slightly. This stretching-out action does not occur freely, as the tightly twisted wires and strands interfere with each other. In a new, well-lubricated rope, the helical strands can pinch down considerably on the elastic core, the amount of stretching out is large, and the modulus is small; while after the core compresses and becomes hardened, the strands cannot pinch down so much, the amount of stretching out reduces, and the modulus becomes greater.

Mr. Howe discusses the question of the stiffness of an ordinary wire rope as compared with that of a rope composed of straight wires, calling attention to the fact that the ordinary rope is much more flexible. He concludes that, on account of the lower modulus of elasticity in tension of the ordinary rope, the bending stresses produced in the individual wires are correspondingly smaller than those in the straight wires, and thus accounts for the greater flexibility. From this reasoning we would expect the ratio of the stiffnesses of the two ropes to be 2.3 to 1. Actually, however, this ratio is much larger than 2.3 to 1. The writer suggests the following explanation of the greater flexibility of the ordinary rope:

If a rope composed of straight wires, having the same number and arrangement of wires and strands as the standard 6 x 19 rope, be bent around a sheave, certain wires will lie on the outside of the curve throughout, and must evidently elongate and be subjected to tensile stresses in addition to bending stresses, while other wires will lie on the inside of the curve throughout, and will receive compressive stresses as well as bending stresses. On account of the axial stresses being thus produced in the wires, the stiffness of the rope will be much greater than that of the 114 wires themselves—about 206 times as great if all of the stretching or shortening of the wires has to occur in the bent portion of the rope, and probably 50 to 100 times as great if the stretching or shortening of the wires can extend out into the straight portions of the rope, as will usually be the case.

Consider now a piece of ordinary 6 x 19 wire rope, say 1 in. in diameter. The strand which lies at the top of the rope at one point is at the bottom about 3 in. away; and the wire lying at the top of a strand at one point is at the bottom about 1¼ in. away. If such a rope, well lubricated, be bent around a sheave, evidently it is unnecessary that any large axial stresses be set up in the wires. Instead, the strands will slip along the core and the wires will slip along each other in the strands. Evidently, then, the wires will be subjected to bending stresses, and in addition only to sufficient axial stresses to make the strands slip along the core, and the wires along each other. These axial stresses will be negligible in a well-lubricated rope.

From the foregoing it is clear that the ordinary rope is much more flexible than the rope composed of straight wires, for the reason that in bending the latter there are set up large axial stresses, as well as bending stresses, in the individual wires, while in bending the former there are set up bending stresses only in the wires. Evidently, therefore, we cannot argue from the greater flexibility of the ordinary rope that the bending stresses in the wires are smaller than those in the rope composed of straight wires.

Mr. Howe, having deduced 12,000,000 as the value of the modulus of elasticity in tension for the entire rope, then assumes that this value can be used in computing the bending stresses in the separate wires, and thus obtains values about half those which have generally been accepted. The writer can see no direct reason why the modulus of elasticity in tension should necessarily apply to the calculation of bending stresses in the separate wires, and feels that the author should give his reasons for making this assumption. The point certainly requires explanation.

The writer has put considerable study on the question of bending stresses in wire ropes, and offers the following formula. It is simple and logical in derivation, so far as he can see, and it agrees with the only tests bearing directly on the question of which he has any knowledge.

Suppose a straight wire of diameter d to be bent 180 deg. around a sheave of diameter D. The length of the bent portion of the wire is $\pi D/2$ and the total angle through which it is bent is π; so that the angle of bending per unit length is $\pi/(\pi D/2)$ or $2/D$. Letting f be the extreme fiber stress in the wire and E the modulus of elasticity of the material, the angle of bending per unit length is also $(f/E)/(d/2)$, or $2f/Ed$. We then have

$$\frac{2f}{Ed} = \frac{2}{D}$$

whence

$$f = E\frac{d}{D}$$

This latter expression is the formula given by Reuleaux, Rankine, Unwin, and other writers, and is evidently applicable to straight wires only.

Now consider a helical wire, such as the center wire of one of the strands of a wire rope. Let the angle between the wire and the axis of the helix be a, and other notation as before. Now suppose the helical wire bent 180 deg. around the sheave. The total angle through which the wire is bent is evidently π, as before, and the length of the bent portion is $(\pi D/2)\sec a$; so that the average angle of bending per unit length is evidently $\pi/(\pi D/2)\sec a$, or $(2/D)\cos a$. We then have

$$\frac{2f}{Ed} = \frac{2}{D}\cos a, \text{ whence } \qquad f = E\frac{d}{D}\cos a$$

Next consider a compound helical wire, such as one of the outer wires in a strand of a rope. Let the angle of lay of the strand be a, and the angle of lay of the wire in the strand be b. As before, suppose the wire bent 180 deg. around the sheave. The length of the bent portion of the wire is $(\pi D/2)\cos a\cos b$, whence we find

$$f = E\frac{d}{D}\cos a\cos b$$

[1] Of the firm of Waddell & Son, Inc., Consulting Engineers.

It appears difficult to the writer to consider the bending stresses to be any smaller than those given by the foregoing formulæ. The total length of the wire and the total angle through which it is bent are known, definite quantities in each case, from which we can deduce directly the average angle of bending per unit length; and from this latter quantity the extreme fiber stress in the wire can be computed directly and without any doubt whatsoever.

While the last-mentioned formula thus appears to be correct, it is, of course, very desirable to check it experimentally. The results of some experiments given in a paper by Mr. R. W. Chapman in the *Engineering Review* of October 1908, entitled The Stress in Wire Ropes Due to Bending, offer an opportunity

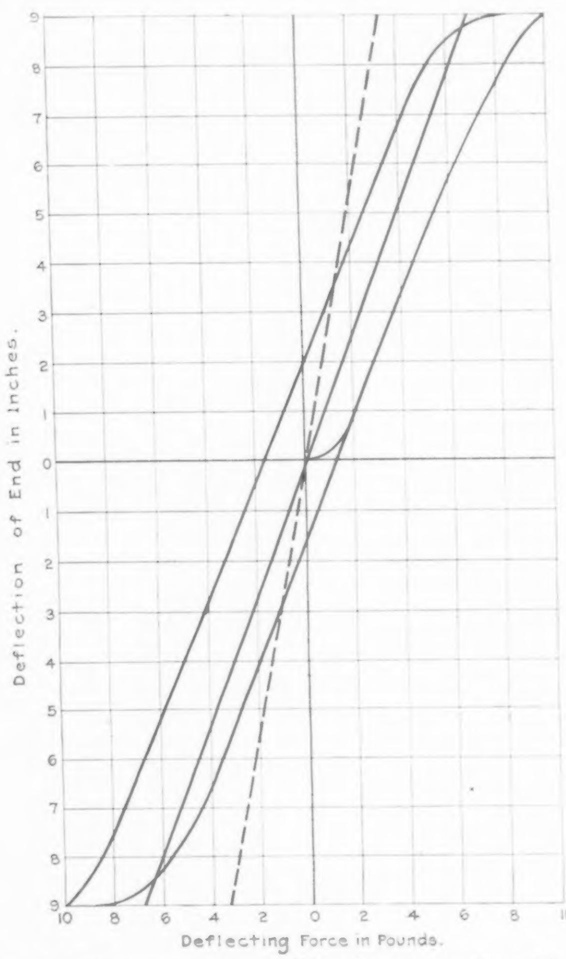

FIG. 1 DEFLECTION OF 6 x 12 WIRE ROPE WITH LOAD 24 IN. FROM SUPPORT

for such a check. Mr. Chapman took a short length of wire rope, clamped one end securely, applied transverse forces to the other end, and then measured the resulting deflections. Figs. 1 to 4 record graphically the results of four of his experiments.

In making such an experiment, evidently we must allow for the effect of the internal frictional forces between the various strands and wires. Mr. Chapman eliminated the effect of these forces in the following manner: He first applied a gradually increasing force in one direction, then reduced it gradually to zero, then applied a gradually increasing force in the other direction, and then gradually reduced it to zero. When the first small forces were applied the deflections were very small, as the wires and strands had not yet begun to slip on each other, and the rope had nearly the stiffness of a solid bar. The flat portion of the deflection curve just to the right of the origin in each figure corresponds to this stage. As the forces were increased the internal friction was overcome, the wires and strands began to slip freely on each other, and the deflection curve turned up sharply and continued practically a straight line as long as the forces were increased. The reduction of the forces then began. The resulting deflection curve was at first very flat, the rope acting as a solid bar while the direction of the internal frictional forces was reversing; then the curve turned down sharply as slippage in the opposite direction began. The forces were then gradually reduced to zero and then applied in the opposite direction, the deflection curve continuing downward as a straight line meanwhile. The forces were then reduced gradually to zero, the deflection curve being at first very flat, then turning up sharply and continuing as practically a straight line. The forces were again reversed in direction, the curve continuing upward and joining the curve first drawn, thus forming a complete loop.

In the loop just described the nearly horizontal portions at the top and bottom, as stated before, represent the deflection curve when no slippage of wires and strands occurs; while the long, steeply inclined sides represent the curve when the wires and strands are slipping freely, with the effect of internal friction eliminated.

Our next step is to compute the theoretic deflection curves for each of the four examples in accordance with the formulæ for bending stresses deduced by Mr. Howe and the writer, and to plot them on the four figures.

The rope used in the tests plotted in Figs. 1 and 2 consisted of 6 strands of 12 wires each, with a hemp core for the rope and hemp cores for the strands. The rope was of ordinary lay, the angle of lay being 18½ deg., and the diameter of the wires 0.082 in. The moment of the inertia of the 72 wires is $72 \times 0.082^4 \times 0.0491 = 0.000159$. The value of EI, according to Mr. Howe's formula, is $12{,}000{,}000 \times 0.000159 = 1910$; while according to the writer's formula, since cos 18½ deg. = 0.95, it is $27{,}500{,}000 \times 0.000159 \times 0.95 \times 0.95 = 3950$.

For Fig. 1, the distance from the support to the end of the rope was 26 in., and the distance from the support to the load was 24 in. The deflection y of the end for a load P is therefore

$$y = \frac{24P \times 12 \times 18}{EI} = \frac{5180P}{EI}$$

For Mr. Howe's formula, $y = 5180P/1910 = 2.71P$, and for
For Fig. 2, the distances from the support to the end of the
the writer's formula, $y = 5180P/3950 = 1.31P$.

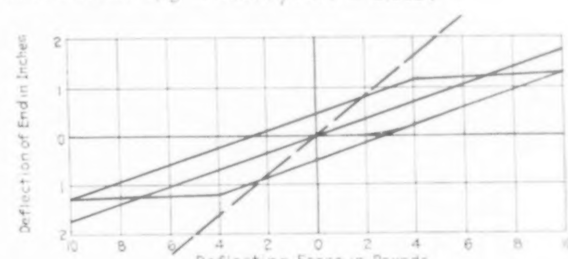

FIG. 2 DEFLECTION OF 6 x 12 WIRE ROPE WITH LOAD 12 IN. FROM SUPPORT

rope and to the load point are 14 in. and 12 in., respectively, so that the deflection of the end is

$$y = \frac{12P \times 6 \times 10}{EI} = \frac{720P}{EI}$$

For Mr. Howe's formula, $y = 720P/1910 = 0.376P$, and for the writer's formula, $y = 720P/3950 = 0.182P$.

The rope used in the tests recorded in Figs. 3 and 4 was a Lang lay rope consisting of 6 strands of 7 wires each, the diameter of the wires being 0.111 in. The lay was not stated, but may be assumed as 18½ deg. The moment of inertia of the 42 wires is $42 \times 0.111^4 \times 0.0491 = 0.000313$. The value of EI, according to Mr. Howe's formula, is $12{,}000{,}000 \times 0.000313 = 3760$; and according to the writer's formula it is $27{,}500{,}000 \times 0.000313 \times 0.95 \times 0.95 = 7780$.

For Fig. 3, the distances from the support and the load point are 23 in. and 21 in., respectively, so that the deflection of the end is

$$y = \frac{21P \times 10.5 \times 16}{EI} = \frac{3530P}{EI}$$

For Mr. Howe's formula, $y = 3530P/3760 = 0.94P$; and for the writer's formula, $y = 3530P/7780 = 0.455P$.

For Fig. 4, the distances from the support and load point are 16 in. and 14 in., respectively, so that the deflection of the end is

$$y = \frac{14P \times 7 \times 11.33}{EI} = \frac{1110P}{EI}$$

For Mr. Howe's formula, $y = 1110P/3760 = 0.295P$; and for the writer's formula, $y = 1110P/7780 = 0.143P$.

The deflection curves computed by the writer's formula have been plotted on each of the four figures as straight full lines, and those figured by Mr. Howe's formula as straight dotted lines. It will be noted that in each figure the full line is approximately parallel to the deflection curve when the wires and strands are slipping freely, with the effect of internal friction eliminated; while the dotted line does not agree at all with these deflection curves. These tests therefore indicate the substantial correctness of the formula proposed by the writer and the incorrectness of the one proposed by Mr. Howe.

The foregoing experimental data, while meager, are all that the writer has been able to find bearing on this subject. It is to be hoped that it can be supplemented in the near future by an extensive series of tests. Mr. Howe, as an engineer of a wire-rope company, may be in a position to carry out such experiments. The question of bending stresses in wire ropes has long been discussed from the theoretic standpoint, and also in its purely practical features; and it seems high time that the two aspects be combined in a scientifically conducted series of tests.

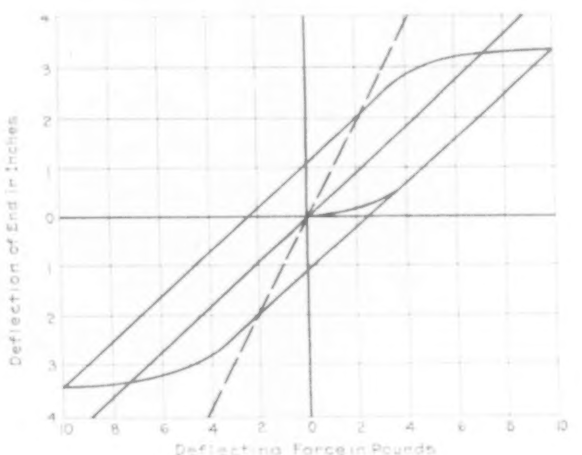

FIG. 3 DEFLECTION OF 6 X 7 WIRE ROPE WITH LOAD 21 IN. FROM SUPPORT

Practical working rules for design can be easily developed from the formula deduced by the writer, namely,

$$f = E\frac{d}{D}\cos a \cos b$$

E can be taken as 27,500,000. For a 6 x 19 rope d equals about $c/15$, where c is the diameter of the rope. Cos a can be taken as 0.95; cos b is 1.00 for the center wire of each strand, 0.97 for the second row of wires in each strand, and 0.95 for the outer row. We then have the following expressions:

Center wire of strand:

$$f = 27{,}500{,}000 \times \frac{c}{15D} \times 0.95 = 1{,}740{,}000\frac{c}{D}$$

Second row of wires:

$$f = 1{,}740{,}000\frac{c}{D} \times 0.97 = 1{,}690{,}000\frac{c}{D}$$

Outer row of wires:

$$f = 1{,}740{,}000\frac{c}{D} \times 0.95 = 1{,}650{,}000\frac{c}{D}$$

As an average value, we can use

$$f = 1{,}700{,}000\frac{c}{D}$$

Since the area of the rope is approximately $0.4c^2$, the product of the unit bending stress by the area is

$$680{,}000\frac{c^3}{D}$$

It has been mentioned that when a rope is bent around a sheave, axial stresses are produced only great enough to make the strands and wires slip, and that for a well-lubricated rope they will be negligible. This is borne out by Mr. Chapman's tests, the widths of the loops being small. If the lubrication be poor, the axial stresses will be larger; and if the rope be rusted so that slippage cannot take place, the axial stresses will be dangerously high. These facts point to the imperative need for thorough lubrication

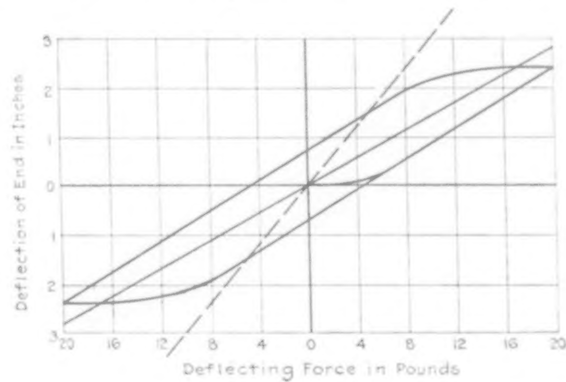

FIG. 4 DEFLECTION OF 6 X 7 WIRE ROPE WITH LOAD 14 IN. FROM SUPPORT

and protection of wire ropes. The lubricant chosen must be one which will penetrate to the inside of the rope and thoroughly saturate the hemp core. A heavy dressing which merely forms a coating on the outside of the rope may be worse than useless, for it may give a false sense of security, while the inside of the rope is devoid of lubricant and possibly even rusting. If an extensive series of bending tests is made, an attempt should be made to secure quantitative values of the stresses in poorly lubricated ropes.

Mr. Howe mentions the destructive effect of reversed bending in ropes. This point cannot be too strongly emphasized. The writer is inclined to believe that reversed bending over sheaves of diameter 60 times that of the rope is nearly as bad as bending in one direction over a sheave of diameter 30 times that of rope.

Mr. Howe also mentions the possibility of using 6 x 37 and 6 x 61 constructions for large ropes. He suggests 6 x 37 ropes for 1½-in. to 2-in. diameters, and 6 x 61 ropes for diameters over 2 in. The writer would hardly agree with these limits for lift-bridge work, as a great deal of trouble is experienced in keeping the ropes properly lubricated, and this fact would discourage the use of smaller wires than is necessary. He would suggest, for this service, that 6 x 19 ropes be used up to 2¼ in. diameter, and 6 x 37 ropes for larger diameters.

MR. HOWE'S COMMENT ON THE PROPOSED FORMULA

The foregoing discussion of his paper was submitted to Mr. Howe, who comments thereon as follows:

The formula as proposed by Mr. Hardesty, namely,

$$f = E\frac{d}{D}\cos a \cos b$$

will give as applied to ordinary 6 x 19 wire rope, assuming that $\cos a = 0.95$ and $\cos b = 0.95$, a value for $\cos a \cos b$ of 0.9025. If this is multiplied by E, it will mean, assuming E to be 27,500,000 as proposed by the writer in his paper, that the modulus of elasticity of the entire rope would be equal to the product of 0.9025 and 27,500,000 or 24,818,750 lb.; or in other words, the modulus of elasticity of the wire rope would be only about 10 per cent less than the modulus of the straight wires. Experimental proof has shown that the modulus is much less than this, as will be noted by reference to curves shown in Figs. 6 and 7 of the paper, the latter of which appeared as Fig. 4 on p. 1018 of THE JOURNAL, December 1918.

Reference has been made by Mr. Hardesty to the paper delivered by W. R. Chapman, published in the *Engineering Record* in 1908, in which Mr. Chapman gave particulars of experiments made to show the value of the bending stress in wire ropes. In that paper Mr. Chapman gives for a $3\frac{1}{4}$-in.-circumference rope (1.034 in. diameter) a bending stress of 18,945 lb. over a 3-ft. sheave. This corresponds to a modulus of elasticity of approximately 24,300,000 lb., which agrees with Mr. Hardesty's formula. However, Mr. Hardesty is basing his conclusions entirely upon the Chapman experiments, so that the agreement of his formula with the Chapman experiments is by no means conclusive evidence of the correctness of the assumptions which have been made.

The entire experimental proof of Mr. Chapman rests upon a series of experiments made by clamping a piece of wire rope in a solid jaw, suspending this rope vertically and then applying various loads at the end of this rope and recording the deflections. For ordinary testing where the material being tested is a solid, this method would probably give fairly correct results; but in testing wire rope in this manner, very serious complication has been allowed to creep in which completely nullifies the results obtained. This will be readily understood when the structure of wire rope is examined. When the clamp is placed upon the wire rope, it is bound solid and no action can take place. Furthermore, the lower end of the wire rope must be held solid in a seizing of wire. This prevents any play of the strands either at the end of the rope or at the point where they are clamped. The distance in between is so short that it seriously affects the results obtained, because it gives a much greater stiffness to the rope than is possessed by the rope under actual working conditions. Any person who has handled wire rope knows that the effect of binding both ends of a short piece of rope is to render it very stiff. If the piece of rope is lengthened, this stiffness is overcome. However, experiments of this kind, while they are interesting, do not give true results as to the working of a full-length specimen of rope, and this is what the engineer wants to know. Behavior of a short specimen under bending does not concern him. It is what the specimen will do when it is put to work in commercial lengths on a large outfit.

Taking the case already cited, namely, the 1.03-in.-diameter rope working over a 3-ft. sheave, the bending stress on a sheave 1 ft. 6 in. in diameter would be, according to Mr. Chapman, 18.94 tons. A rope of this diameter would have an ultimate strength of 30 tons for crucible steel, or 38 tons for plow steel. It is not an unusual case for a derrick to be equipped with rope working under these conditions, carrying a load of 6 to 7 tons. Were the bending stresses as high as these Chapman experiments would indicate, the life of the rope would be exceedingly short, because the material would be worked at or near the elastic limit at all times, even without any additional load. Other similar cases might be cited wherein these conditions are duplicated. This of itself is conclusive proof that the bending stress cannot be as great as would be computed either by the Chapman formula or by Mr. Hardesty's formula as he proposes it.

Were the stress as high as calculated by Messrs. Chapman and Hardesty, wire rope would give practically no service at all under the conditions noted, whereas we know of numerous cases where ropes have lasted from six to eighteen months under conditions similar to those just noted. The practical results of rope operation offer added proof, therefore, that the bending stress is a much smaller factor than indicated by Mr. Hardesty's calculations.

In a note dealing with the possibilities of the commercial airships, issued recently by the British Air Ministry, it is predicted that future airships will have a capacity of 10,000,000 cu. ft., a propelling apparatus of 6000 hp., and a maximum speed of 85 miles per hour. These ships would be 1000 ft. in length, 150 ft. in overall height, possess a range of 20,000 miles, and could stay aloft for three weeks without requiring refilling. The crew would consist of three officers and 26 men, and the freight capacity would be 200 tons. The cost of a 10,000,000-cu. ft. airship is estimated at between \$1,000,000 and \$1,500,000. From *Aviation*, February 1, 1919.

RECOLLECTIONS OF ERICSSON

As the ninth of this month marks the thirtieth anniversary of the death of the noted engineer, Captain John Ericsson, it has been thought fitting to recall his many and great achievements, as recounted by his friend, George H. Robinson, in Recollections of Ericsson, a published address which was delivered before the Commercial Club at Providence, R. I., on March 24, 1894. This little book has recently been donated by George L. Shepley to the Society to be placed in the Library, and the following paragraphs are reprinted as showing the variety and scope of Captain Ericsson's work.

In John's earliest boyhood his delight was to be in the mines studying the machinery and making drawings. At the age of nine he constructed a sawmill, using a watch spring for a saw, transformed by the aid of a file borrowed from a neighboring blacksmith, and from a broken tin spoon he cast his crank. He built a water wheel and attached his sawmill to it, and had the delight of seeing the machinery in actual operation sawing sticks. The next summer he designed a pump for drawing water from the mines. The motive power was derived from a windmill. He had never seen a windmill, but he built it from descriptions given by his father. It failed to work because it had not been adjusted to the changes of the wind. His father, describing a visit to a neighboring mine, spoke of a ball and socket joint. The idea was seized at once by John, and he joined the connecting rod for his crank to the pump lever with a ball and socket joint. From early infancy John Ericsson was connected with great engineering works, the Göta Canal being a marvel of canal building even for the present day.

JOHN ERICSSON, THE THIRTIETH ANNIVERSARY OF WHOSE DEATH OCCURS ON MARCH 9

From a Painting Presented to the Society by the Late Prof. F. R. Hutton

At seventeen the military spirit took possession of him, and after much opposition from his engineering advisors he was assigned to the 23d Regiment Rifle Corps, with the rank of ensign. Soon after he joined the service orders were given to survey the District of Jemtland, where he was stationed. The work was secured by competition, and Ericsson easily won a prize. Ericsson was so rapid of execution that he performed more than double duty, and he was carried on the payrolls as two persons in order to avoid criticism and charges of favoritism. At the age of twenty-two he constructed the flame engine.

Showing the drawings of his flame engine to King Charles, he was advised to go to England, where he could find a more fitting field for his ambition.

Now followed invention after invention in rapid succession. An engine using steam combined with the gases arising from the combustion of coal; next a start toward his future caloric engine—an engine with two cylinders; in one of these was a loosely fitting piston, and directly under this he placed his fire, the loosely fitting piston actuating his working cylinders. Then he constructed a pumping engine, consisting of a series of cisterns rising one above the other; by ex-

hausting the air from these cisterns in succession the water was raised to the desired height.

In 1828 he constructed an air compressor, which was placed in successful operation in the mines near Truro, in Cornwall. It had an air cylinder of twenty inches diameter and five feet stroke.

In 1828 he patented artificial draught, a year before Stephenson made his reputation by the application of the same principle to his locomotive "Rocket." The year 1828 was marked by another revolutionary invention by Ericsson, the steam fire engine. He built several, but a generation passed before his invention was used, and then his fire engine came into service almost without change.

Now comes the era of locomotive building. The officials of the Liverpool & Manchester Road published an advertisement offering a prize of £500 for the best locomotive conforming to certain stipulations. Five months were allowed for completing the engine. Of the twenty-two weeks, fifteen had passed before Captain Ericsson learned of the competition. He had seven weeks only to make his plans and build his machinery. He had never built a locomotive. John Stephenson was engineer of the Liverpool & Manchester Road, and had been five years at the head of an establishment manufacturing such locomotives as were in use in the colleries; and he had the further advantage of controlling the road that ordered the trials, and the sympathy and support of its officials. His locomotive "Rocket" was virtually completed before Ericsson's "Novelty" was begun. Stephenson tested the "Rocket" in actual practice and remedied its defects, that would have been fatal if left to the day of trial. Ericsson could make no test before trial, and on that day he had to adjust the wheels of the "Novelty" to fit the track. Stephenson had been obliged to conceal the speed he hoped to attain, and ten miles had been spoken of as the limit of possible speed.

For the trials five engines entered; three were of little moment. The contest was between the "Rocket" and the "Novelty." Stephenson depended on chimney draught. Ericsson provided his engine with artificial means for supporting the combustion in the boiler furnace. A blowing machine was applied, moved directly by the engine so that the supply of air was greatest when the engine worked at maximum speed. The result was the "Novelty" shot by the "Rocket" like a projectile. The "Novelty" did a mile in fifty-six seconds. The second day the "Novelty" blew out several tubes and Ericsson withdrew her from the contest. The following year Ericsson built two locomotives—the "King William" and the "Queen Adelaide." To these was applied for the first time the link motion for reversing steam engines.

In 1830 he patented an apparatus for making salt from brine. In 1831 a rotary engine; two were built on a large scale, one being placed in a steamship. The next year he applied a centrifugal fan blower, driven by a separate small engine, to the steamer "Corsair." The independent blower system is now universally adopted, but not one in ten thousand who uses it knows to whom he is indebted.

In 1833 he took out his first patent for caloric engines. The use of high temperature in the air engine suggested another step with steam. He followed with his "Superheating Condenser Steam Engine." The deep-sea sounding machine, known as Ericsson's Sea Lead, was his next important invention.

In 1836 he patented an automatic file-cutting machine. The next greatest gift to this century—the invention that revolutionized commerce, that made possible the utilization of that other great invention, the cable—was the screw propeller. This was the first direct-acting screw-propeller engine ever built.

In 1854 Ericsson sent to Napoleon III a plan of a monitor, differing only from what is known as the original "Monitor," in that the turret was a rounded dome. These plans were not adopted, but the Emperor was greatly interested, acknowledging them personally and sending Ericsson a gold medal testifying his appreciation.

In 1862, when the days of our Civil War were darkest, the Southern Confederacy was fitting out the "Merrimac"; with her they hoped to capture every port on the seaboard, destroy our commerce and compel the surrender of Washington. Ericsson, the best-equipped American of the day, was entirely ignored. He had become a citizen in 1848. His friend, DeLamater, was familiar with the plans sent to Napoleon. These plans had been the result of thirty years' study, and were conceived in his boyhood. "You assume correctly," he wrote to his friend Fox, in 1875, "that the plan of the 'Monitor' was based on the observations of the behavior of timber in our great Swedish lakes. I found that while the raftsman in his elevated cabin experienced very little motion, the seas making over his nearly submerged craft, those seas at the same time worked the sailing vessels on their beam ends." He saw then the impregnable warship and only waited the call.

On August 3, President Lincoln approved an act appointing a board to determine upon building ironclad steam vessels. An advertisement inviting proposals was published. One of the first sets of plans recommended for adoption by the Committee was presented by C. S. Bushnell, and he was awarded a contract to build the vessel known as the "Galena." He consulted Mr. DeLamater, many of the naval men having doubted her ability to carry the stipulated amount of iron. Mr. DeLamater advised him to go to Captain Ericsson, whose opinion would settle the matter definitely and with accuracy. He called on Ericsson, laid the matter before him and was requested to call the next day for his verdict. It was entirely favorable. Captain Ericsson then produced his model and plan of a monitor sent to Napoleon. He found a most willing champion in Bushnell, and gave him both plan and model to present at Washington.

The next day the board condemned the plan. Bushnell labored with them and won over Admirals Smith and Paulding, who promised to report favorably if Captain Davis would join them. Captain Davis told Bushnell "to take the little thing home and worship it, as it would not be idolatry, because it was in the image of nothing in the heaven above or on the earth beneath, or in the waters under the earth."

Bushnell felt that the only way to succeed was to have Captain Ericsson present in Washington. He came to New York, saw Mr. DeLamater, and together they went to Beach Street. The exact facts were not given to Captain Ericsson, but he was told that some explanations were needed that he alone could make. He went to Washington that night. He was told as soon as he appeared before the board that his plans had been rejected. His indignation impelled him to withdraw at once, but he wisely asked why the plan was rejected. He was told the vessel lacked stability. He explained with elaborate demonstration and so convincingly that Commodore Paulding said frankly and generously: "Sir, I have learned more about the stability of a vessel from what you have said than I ever knew before." He was told the next day by Secretary Welles that a contract would be awarded, and asked to proceed at once with the work. The contract was signed October 25, 1861. The keel of the "Monitor" was laid on the same day. Steam was applied to the engines at DeLamater Iron Works December 30th. She was launched January 30th, and practically completed February 15, 1862. She made her first trial trip February 19th. Ericsson's work during that three months was herculean. Not only the necessary labors, but the worries from continued doubts sent from Washington required almost superhuman power.

The "Monitor" left New York harbor March 6, 1862, commanded by Commodore Worden. She arrived at Hampton Roads on the morning of the 9th, and before the sun set that day the famous battle of the "Monitor" and the "Merrimac" was done. What was due to the man whose brain had conceived and whose will had directed this mighty work that had delivered a nation? The "Monitor" conquered the "Merrimac" before payment had been made, before she had been accepted by the Government.

The war vessel was changed in one day. The monitor type became the war vessel of the world.

Ten years later we had the "Cuban scare," and the "Dictator" was hurried into active service. She left for the rendezvous in charge of her consort, who lost her off Savannah during a bad storm. The consort put into that port, and it was telegraphed from there that the "Dictator" was lost and all on board. Captain Ericsson was overwhelmed at the news, but, seeking a cause, he finally concluded that her steering gear had become disarranged. The next morning Captain Ericsson sent word: "He had been thinking all night, and had concluded that her steering gear could not get disarranged. The "Dictator" would report at Key West within twenty-four hours." She arrived at Key West a few hours later.

In 1869 the Spanish government wished to protect Cuba from filibusters and insurgents. Captain Raphael de Aragon came to Messrs. DeLamater & Co. commissioned to spend a considerable sum, but without any plan. Naturally, Ericsson was consulted. He had just been studying the defense of Sweden and suggested a scheme at once; to build thirty gunboats, each armed with a 100-pound gun mounted on her bow. He named two conditions only—to make his plans without submitting, and that DeLamater should execute the contract. These thirty boats were completed in thirty weeks, and some years later the designer and builder each received from the Spanish government the Commander's Cross of the Order of Isabel la Catolica, in recognition of their services.

Ericsson now was at work on harbor defense, and developed, after years of trials, the "Destroyer," which carried a submarine gun and discharged a projectile thirty feet long, loaded with three hundred and fifty pounds of explosive. For General Grant a test was made, and she performed what her designer claimed for her. She hit a target ten feet square, ten feet below the surface of the water, and traversed the distance—300 feet—in less than three seconds' time.

I am aware of what injustice I am doing Captain Ericsson's work; I cannot even speak of his conclusive researches regarding solar heat, of the solar engine he built and ran in Beach Street, developing ten horsepower from the direct rays of the sun; of the caloric ship "Ericsson," of his numberless achievements. The history of his honors and decorations almost universally conferred would alone considered make an interesting talk. He was recognized by every Government in Europe and by most of the leading societies in the world. He received in 1862 for his "Caloric Engine of 1858" the gold and silver Rumford medals. The prize was founded in 1796 by Count Rumford, a native of Concord, N. H., and was in the gift of the American Academy of Arts and Sciences. They awarded it in 1839 to Robert Hare 43 years after its foundation, but 23 more passed before another was found worthy of the award.

On March 9, 1889, on the anniversary of the battle of the "Monitor" and the "Merrimac," came to this man rest.

On August 23, 1890, the remains of Captain Ericsson were placed on board the "Baltimore" and sent to Sweden. His native government asked it. His adopted government granted it with every honor possible, sending him home on her finest warship.

ENGINEERING CONDITIONS IN FRANCE

Return of American Engineer-Delegates Who Have Been Conferring with French Engineers on Reconstruction Problems. Meetings Held in Boston and New York

As announced in The Journal for December 1918, an invitation was extended to the American Society of Civil Engineers by the Société des Ingénieurs Civils and the Committee of the French Engineers' Congress, for a delegation of American engineers to go abroad to discuss some of the problems involved in the rehabilitation of France. The delegation was organized by the Civil Engineers with the coöperation of the other American national societies, and Past-President Charles T. Main attended as delegate from The American Society of Mechanical Engineers.

During the visit the French Congrès Général du Génie Civil passed a resolution asking the formation of a permanent Franco-American Committee and the French members of such a committee were duly appointed by the Congress, consisting of a general secretary and the presidents of the five committees with whom the members of the American delegation had been coöperating, as follows: Ports and Navigable Waterways; Water Power; Roads; Agricultural Development and Technical Education. To meet the desire of the French engineers the American delegates consented to act temporarily as members of the international committee, and pending action in the matter by the councils of the several American societies.

It is a pleasure to note that a return trip by a delegation of French engineers is expected to occur this month.

The American engineers report a successful and interesting trip and upon their return two meetings were held, one in Boston at which Past-President Main was welcomed and one in New York where addresses were made by several members of the delegation. Reports of these meetings follow, together with the text of a brief address made by Mr. Main at Martigues on the occasion of entertainment by the Chamber of Commerce of Marseilles.

Dinner in Boston for Past-President Main

The January meeting of the Boston Section, which was held at the Engineers' Club, January 31, was devoted to welcoming Past-President Charles T. Main on his return from France in connection with the rehabilitation of that country. Mr. Main was first welcomed at a dinner of about fifty members, after which he addressed an audience of members which filled the auditorium of the Engineers' Club.

The questions which the party of engineers, of which Mr. Main was a member, were asked to consider included commercial ports, water power, roads, technical education, mines, mining and agriculture. Mr. Main covered many phases of the work accomplished by the American engineers, and the following are a few of the points mentioned:

The French engineers are very capable. Their knowledge of theory is perhaps better than ours. Their plans are made very thoroughly; but due to the almost universal lack of standardization, with every man doing his work in his own personal way, the facility with which operations are completed seems relatively slow.

In Paris a munitions works capable of turning out 20,000 shells a day was begun in May 1918 and completed in four months. This plant was of sufficiently substantial construction and was admirably arranged for speed and economy of producing shells. In another place a plant was constructed which at the time of the signing of the armistice was delivering 25 tanks a day.

The coal shortage of France is leading to consideration of hydroelectric development, especially of the waters from the Alps and Pyrenees. This power is being largely used for electrochemical industries and the electrification of railroads is being very seriously considered. The hydraulic turbines which are used are of efficient design and contain wheels similar to those in a steam turbine.

A Franco-American Engineering Committee was formed. The American representatives were asked to serve as members of this Committee, which they agreed to do temporarily until they could report to their different engineering organizations.

A visit of the French engineers to the United States was arranged for March next, when they will study the electrification of railways and visit the larger manufacturers of railway and power-plant apparatus.

The actual damage to France caused by the war has been estimated at about \$14,000,000,000. This is for physical damage only, and does not include consequential damage. This approximate estimate of losses is divided as follows:

For buildings	20,000,000,000 francs
For furniture	5,000,000,000 francs
For grounds, cattle and forests	10,000,000,000 francs
For industry	20,000,000,000 francs
For public works	10,000,000,000 francs

It has been estimated that at least 250,000 buildings were totally destroyed, 250,000 partially destroyed, and at least 250,000 acres of land so devastated as to require restoration.

The French laws are such that an alien cannot hold more than one-third of the capital stock of a French company, which leaves the control in French hands.

Contrasting French technical schools with American schools, the French seemed to require less mechanical equipment; and the actual working out by the student of problems similar to those encountered in the daily practice of engineering, the actual handling of equipment such as electrical machinery and the doing of work on machine tools in the school shops, was much less common than in America.

The ability of the Americans in forcing construction work made an impression on the French, who intimated that some Americans might be desirable as superintendents and foremen in their plants.

The suggestion of the French to improve transportation by the construction of more canals was not favored by the American engineers, because under the average conditions in America railroads have proved more advantageous.

Engineering Problems Connected with Reconstruction

Address By Past-President Main at Martigues, France

We consider it a very great honor and privilege to be allowed to come to France to discuss with you the problems of reconstruction and redevelopment. We have, in our own country, many problems of reconversion from war to peace activities. We were unprepared for war, which was a possibility, and we are unprepared for peace, which is a certainty.

There are now before Congress two bills contemplating the creation of a commission for the discussion of such problems as labor, capital and credit, public utilities, demobilization of industrial and military resources, foreign trade, continuance of existing industries, agriculture, adequate production and effective distribution of coal, gasoline and other fuels, shipping, shipyards, ownership of yards and ships, housing conditions, technical education, the supply, distribution and availability of raw materials and foodstuffs, conservation of natural resources, transportation by rail and water, reorganization of Government bureaus on an economical and efficient peace basis, and consolidation and amendment of acts of Congress.

These are only a repetition of your own problems. In each of the belligerent countries there are the same problems to face, except that you have the additional one of the reconstruction of the devastated territory. We shall be very glad if we can be of any assistance to you in any of these problems.

Nearly all of the problems suggested are directly and indirectly engineering problems, and the assistance of engineers will be

needed now more than ever before, and the engineers should look upon them with a broader vision and should take a more active and helpful attitude toward public affairs and industrial relations which they have considered heretofore beyond the scope of their work.

You have asked us to consider with you the problems of Harbors, Water Powers, Roads and Pavements, Agriculture and Technical Education.

We have visited some of your ports and are very much impressed with the great possibilities of their further development. It would be presumptuous of us to attempt in the short time we have given the subject to say which is the best method of development.

The question of roads and pavements is a more definite one, and our committee has made its report with definite recommendations.

The problems connected with agriculture are so involved in the laws of France that we may not be able to give the advice you desire, but our committee has made a report which may be helpful.

Your technical schools are good, but we think it would be of great benefit to this country if we could have an exchange of professors and some of your professors and students could spend a year in some of our technical schools.

We have seen some of your water-power developments and have had presented to us in detail several projects for the development of hydroelectric power. The possibilities appear to be satisfactory for the development and use of some or all of these, especially when considering the high price and the possible shortage of coal.

The problems of water-power development are the same in all countries, with varying local conditions, and are largely problems in economics. It cannot be expected that private individuals or corporations will invest in enterprises of this sort that do not promise a fair return on the investment. If the cost of construction for a given project is so great that a fair return cannot be earned, it will remain undeveloped, unless the Government assists in financing it. Such assistance would be warranted if in addition to the power generated there were public benefits to be derived, such as prevention or diminution of floods, irrigation, or conservation of fuel, which would preserve for future generations the heritage which properly belongs to them.

Nearly all of the developments in our country use all the flow of the stream for some months in the year, and for the remaining months there is a deficit of water power which is supplied by steam power. The economic limit of development is also one of economics and can be solved within reasonable limits. As the requirements of business grow more exacting, it becomes absolutely necessary to have constant power assured.

In our own country considerable attention is being given to the construction of storage reservoirs, but no great progress has been made in the actual construction of such reservoirs for power purposes only. We have had very little encouragement for water-power development owing to the laws and the attitude of the law makers. A water-power bill is now under discussion in Congress, and it is hoped that a bill will be passed which will be liberal enough to stimulate developments. We were surprised to see in the vicinity of Grenoble two high-head powers, which were originally developed in 1868-1869, thus antedating any of the high-head developments in America.

Transportation problems are getting to be very serious with us. At least one-quarter of the transportation is for the coal used by the railroads. The development of electric transmission of power has made it possible to change many of our previous methods of doing business, and we are now discussing the feasibility of constructing steam plants near the mouth of the mines and at tide-water of larger capacity than have previously been built. We are also considering the further and more efficient development of water power, and the running of great connecting trunk lines for the transmission of electric current and the electrification of the railroads. If these projects could be carried out a large portion of the railroad equipment would be released for other purposes and less coal would be burned.

It appears to us that these are the general lines along which you are proceeding and should proceed with your future developments. The principal projects should be considered together, and the successive developments made as they will best fit into the general plan. Competition may be ruinous, but concerted effort will prove to be successful.

We have been privileged to visit some of the devastated areas and to get a definite idea of the damage done to your country. We cannot express the depth of our sympathy. We can be of some assistance to you in transmitting our impressions first hand to the citizens of our own country.

Our delegation is deeply indebted to you and to every one for the gracious courtesy which has been so uniformly accorded us. We shall carry back to America a memory which will last as long as we live. On behalf of our delegation, I desire to thank you all for these courtesies.

Engineering Delegates Tell of Their Observations Abroad

On February 10 the delegates to the French Engineering Congress presented to a meeting of the four engineering societies, held at New York, an informal report of their trip and of their impressions of engineering conditions in France.

Dr. George F. Swain described the work of the Congress and spoke interestingly of certain aspects of the present situation in France. Speaking of Waterways and Transportation he said in part:

"France has done more than any other country in Europe to develop a system of internal waterways, canals and navigable rivers. All of these are owned and maintained by the government, which has assumed the debt and pays the interest on the debt and maintains the river and canal work. The man who wants to operate a boat on a canal simply buys the boat and operates it; and when one pays for canal transportation he simply pays the boatman his charge, whatever it is.

"The railroads are dominated by the government, but of the seven railroads of France, six are owned by private corporations while the seventh is a state railroad. Even for private corporations the state assumes the risk of all funds for construction. The companies pay all expenses of maintenance and operation. They pay due taxes to the government and they are allowed to earn a dividend for their stock holders which amounted, three years ago, to something over 4 per cent.

"The French have a great idea of developing waterways and the only point in which the members of the delegation were not quite in accord with the French engineers was with regard to their plans for spending large sums of money in building canals and making rivers navigable. Apparently no study was being made of the economics of these questions; no statistics of transportation, no study as to whether they could get any return from the expenditure."

With regard to technical education, one of the subjects investigated, Dr. Swain said:

"I think the French appreciate that with them as with us, the events of the last few years ought to lead to changes in educational methods. It is a great thing to have one nation learn from another and the best time to learn is when a man is young. We emphasized at every opportunity the desirability of having Americans go to France to study and Frenchmen come to America to study.

"Their engineering schools are in the hearts of the cities where they cannot grow, where they have no room for laboratories or any expansion. One of the ministers said they were going to appropriate large sums for technical education, and I think they will. I hope they will open their schools to foreign students without undue petty requirements or restriction and I think there will be, in the future, an interchange of our young men with their young men. I think there is a good prospect of that proceeding."

Mr. George W. Tillson, a civil engineering delegate, gave an account of French plans and methods of road construction. In the course of his remarks he said:

"I, personally, was considerably surprised to find that the

question of roads was one for discussion, because I knew that the French for many years had the reputation of having probably the best system of roads in the world. I was surprised that they should ask this new country of ours for anything in the way of information on that subject, but, when we came to confer with them, it was very simple."

It had been pointed out to the American delegates, however, that the development of motor traffic necessitated new methods of construction and the two methods which seemed to appeal to the French engineers were the construction of asphaltic macadam by the penetration method and by the mixing method.

"We told them," Mr. Tillson said, "of the miles of concrete roads that have been built in this country during the past ten years and the good results that have been obtained and that they could expect better results in France because they did not have the great ranges in temperature which we have here and which cause cracks in the concrete. They were, however, inclined to disapprove of this method because some years ago a concrete road had been unsuccessful, and so without further experiment they had dropped this manner of road building. We urged further experimental work and while our ideas did not appeal very strongly to them, the Congress, nevertheless, agreed to recommend the use of concrete where the materials were so convenient that it would be cheap."

The question of finances as related to road building was of special interest according to Mr. Tillson. American methods would not do, for while they liked the idea of a special assessment, such as we have in this country, and seemed to think that it would be proper that the abutters on the road should pay a certain amount of the cost, under present conditions in France they thought it would be hardly possible to bring it about.

The Mining Engineers were represented by Mr. E. G. Spilsbury, who described a trip to the devastated coal regions of Lens. Before the war this section had 60 mines and 18 were models of mining appliances.

The buildings were all stone or concrete, surrounded with steel structures, washeries and grading machinery with massive steel and concrete storage bins and loading equipment. Of all this nothing remains except tangled masses of broken steel. Not content with letting these structures take their chance of being wrecked by shell fire, the Huns systematically cut the steel supporting legs of the railroad ways and with cables to heavy motor trucks pulled them over. Every hoisting pump and machine was either dynamited or broken up with sledges and every boiler showed signs of having been exploded from the inside, besides the shell perforations in some of the steel domes. The electrical generators and motors had been taken out and presumably shipped to Germany.

The mines were flooded by cutting ditches to some of the shafts and laying pipes to the more distant ones through which they turned the waters of the Somme canal.

It is estimated that it will take 30,000,000 hp. for a year and a half for dewatering. They have a small surface coal deposit about 12 miles from Lens where they are now building a power station from which to run pumps. A thing which was very apparent to the delegates was that the French are not seeking the help of foreign engineers to aid in this work. They have plenty of talent of their own and they are going to use it and use it more or less exclusively.

Hydroelectric developments were discussed by Mr. Lewis B. Stillwell. There is at present, according to Mr. Stillwell, 4,500,000 to 6,000,000 undeveloped horsepower in France, and while our assistance in its development will be welcomed, we can teach the French practically nothing in the technicality of the hydraulic art and the construction of factories. The only matter they may have to learn from us in respect to the work, is that our experience has been on a somewhat larger scale, and with higher pressures. We can, however, assist them in standardizing their plants and systems. Even now, such important factors as frequency and voltage are not standardized, and interconnection, which is so desirable, cannot be accomplished until a standard is universally adopted.

They will also have to carry out the idea of standardization in great detail, if they wish to get the cost of production down to a reasonable basis. At present, the idea of individuality is carried to an extreme that is astonishing to us. The smaller manufacturer who makes a lamp socket, for example, or the retailer who sells the lamp socket will call on the manufacturer to make his a little different from the other kind, on the theory that having obtained his original customers he can hold them as they cannot get that particular type anywhere else.

Other speakers of the evening were Mr. George W. Fuller, who discussed French agriculture and finance; Mr. A. M. Hunt, who outlined the French plans for developing their ports and the proposed east and west railroad to Basle, Switzerland; and Mr. Nelson C. Lewis, who described a trip through the "Smiling Valley of the Marne."

Past-President Charles T. Main, who represented the A.S.M.E. on the delegation, was unable to be present, due to an engagement at Boston.

FUEL PROBLEMS OF THE PACIFIC COAST

The Possibilities of Fuel-Oil Conservation Through Its Economical Use and the Development of Hydraulic Power

IN harmony with the spirit of the times, fuel conservation vs. the great demand for power occasioned by our many war industries, was the subject for discussion at a point meeting of the local sections of the A.S.C.E., A.S.M.E., A.I.M.E., A.I.E.E., and A.C.S. at San Francisco shortly before the signing of the armistice. Although the problems of peace now occupy our minds, we must be governed by realities, and much of the discussion given at that time is pertinent to the reconstruction period through which we are now passing.

In addition to the papers which are abstracted below and which bear directly on the subject indicated in the title, others were presented by Major George F. Sever, U. S. A., Capt. Robert W. Brewer and Prof. Edmund O'Neill, respectively. Major Sever told of the careful study he was making of the electric power situation on the Coast for the Government; Captain Brewer gave particulars regarding the various methods and devices employed in conserving fuel in England; and Professor O'Neill pointed out the numerous ways in which the chemist had been of service in solving problems connected with the economical burning of fuel.

Fuel Conservation

A. E. SCHWABACKER[1]

In presenting his subject Mr. Schwabacker outlined the plans of the U. S. Fuel Administration for carrying on its important work. He said that America's war needs called for 100,000,000 more tons of coal in 1918 than in 1917, and 200,000,000 tons more than in 1914. This tremendous increased demand had to be met by most intensive work in three directions: increased production, efficient conservation, and a distribution which would insure against lost motion.

While every European country had decreased its coal produc-

[1] U. S. Fuel Administrator for California.

tion since the war began, the United States had increased its output by 50,000,000 tons during the first year of the war; 735,000,000 tons of coal were necessary for our railroads, ships, war industries and people; 100,000,000 tons had to come from the anthracite fields and the remainder of the amount from the bituminous.

In 1917 there were produced about 330,000,000 bbl. of oil, and in 1918 an additional amount of approximately 23,000,000 bbl. was required.

Two limiting factors in the production of coal were labor and transportation. With a decreased labor supply, and increased demand, full production had to be obtained by greater efficiency of mine workers and conservation by industrial and domestic consumers. The Production Bureau of the United States Fuel Administration appointed a special committee at each mine. Three members were chosen by mine operators, and three by the workers. This committee urged miners to work eight hours a day six days a week, to report the number of tons produced, and to discourage shortages of hours or absence from duty.

Before the war the demand for domestic coal during the summer was so light that miners would often seek other occupations. The Fuel Administration encouraged the early buying and storage of coal by patriotic appeals to consumers through a "Buy Early" campaign. This was a tremendous success and kept the demand upon many mines during the summer months up to maximum.

The Fuel Administration created a labor bureau, wherein the matters pertaining to labor in the coal-mining industry remained under the jurisdiction of the United States Fuel Administrator. Strikes in the industry were reduced to a minimum, thanks to the efficient work of this bureau.

A zoning system which eliminated cross-hauling of coal and avoided waste of transportation was estimated to save over 20,000,000 car-miles a year in the movement of coal. A consequent saving of fuel that would otherwise be used in this transportation was also made.

Before the organization of the Fuel Administration shipments of bunker coal to seaports contained as high as 10 per cent of foreign substance. Strict regulations introduced later, however, prohibited the delivery of any coal to Atlantic or Gulf ports for bunkering purposes that was not up to the Fuel Administration's specifications.

Fuel oil also had to be conserved to the utmost for the use of ships. Mr. Rossetter, Director of Operations of the United States Shipping Board, had advised that the emergency fleet could be operated by American seamen in competition with foreign vessels manned by cheap Asiatic labor, providing fuel oil was burned instead of coal.

The speaker said that the experience of H. R. Collins, of the Fuller Engineering Co., with many grades of coal, indicated that every solid carbonaceous fuel from lignite to the graphitic anthracites of Rhode Island, would yield its maximum measure of heat if burned in pulverized form. The cement industry alone, in California, consumed 1,700,000 bbl. of fuel oil per annum. If California low-grade lignites and sub-bituminous coals were pulverized and utilized as fuel to serve this industry, approximately 350,000 tons of coal in the pulverized state would release for ship's use 1,700,000 bbl. of fuel oil.

The Fuel Administration had endeavored to stimulate development of hydroelectric power to serve as a substitute for fuel oil and coal. Central generating stations were recognized to have far greater possibilities for fuel conservation than smaller isolated plants, and the elimination of less efficient plants was being urged.

Interconnection of power companies had been accomplished in many localities through the efforts of the Fuel Administration. Substantial savings of fuel oil and coal had been made possible, particularly in those communities where water-power plants had been interconnected with those operated by steam. By the closing or consolidation of many so-called "less essential" industries, supplies of fuel, raw materials and man power had been made available for war industries.

Lightless nights were estimated to have saved 500,000 tons of coal. Skip-stop systems on street railroads promised to save 3 per cent of fuel consumption and the daylight-saving plan had saved approximately $1\frac{1}{2}$ million tons of coal per annum.

Production of Energy

A. M. MARKWART[1]

Mr. Markwart drew attention to the vital importance of developing the water-power resources of the country. Our coal measures, he said, were sufficient for several generations, but production had already reached the point which, with the supply of oil, would answer the most essential needs only if these supplies were guarded by the most careful restrictions as to their use. Naturally, in increasing the supply of energy, we should give some consideration to that form which would best serve our present and future needs.

The production of coal took an enormous amount of man power each year, the value of which was lost after the coal was consumed, and the natural resource was diminished accordingly. This was equally true of oil, whereas the human effort expended on the creation of a hydroelectric plant was much less and it was spent but once; its result was conserved throughout the plant life, and a corresponding amount of wealth was created.

In developing the greatest natural resource of the country—"white coal"—a beginning had barely been made. Here was a practically inexhaustible supply of energy. The undeveloped water power of the nation had been variously estimated at from 55 million commercially to 225 million horsepower theoretically. Accepting the lower estimate it was said that 40 million of this was to be found in 13 western states and mostly under Federal control. Of this there was perhaps 5 million in the state of California, but not over half a million of which had been developed. The total developed water horsepower of the United States was stated to be about $6\frac{1}{2}$ million, and the steam-engine horsepower, including railroad locomotives, 28 million. It was evident that there were great water-power opportunities, many of which were favorably situated for immediate development, to satisfy the needs of a wide and constantly increasing consumption.

The laws under which water power might be utilized, however, were so stringent that there had been a stagnation in water-power development. While in normal times policies were deterrent, in war times they were practically prohibitive, and the obstacles to be encountered were so numerous that corporations could not undertake any kind of expansion whatsoever. To develop a hydroelectric project in California it was necessary to obtain permits from the Forest Service (if public lands were involved), the State Water Commission, the Railroad Commission, the Commissioner of Corporations, and the Fuel Administration; and then, when all of these permits had been obtained, it was necessary to secure a certificate from the Capital Issues Committee that the issuance of the securities in connection with the project was not incompatible with the interests of the United States. And after all this had been done, the War Industries Board, the Railroad Administration and the Selective Service Boards would thus determine respectively whether or not the necessary materials of construction might be obtained, transportation arranged, and men secured to accomplish the physical work. These restrictions were doubtless necessary to safeguard the interests of the public and to maintain the conduct of the war, but they did not facilitate the development of this enormous wealth of potential energy.

It would therefore seem that sane, accelerant effort should be directed toward the utilization of hydroelectric power rather than exclusively toward the exhaustion of coal and oil, with the consequent waste of man power and absorption of transportation facilities. Water power was now locked up by prohibitive restrictions. We should have done with this kind of conservation and should proceed with the development and utilization of this tremendous resource in order to save for posterity some of those non-renewable natural resources upon which this generation was drawing so heavily.

[1] Civil Engineer.

Gas as a Conservation Measure

J. A. BRITTON[1]

The essential and fundamental elements of conservation are being taught the American people of today, who are rapidly learning their lesson and who patriotically desire to conserve that which the Government requests them to conserve. In reference to the economics of heat, light and power under the conditions of distribution as they exist in the north central part of California, the alternatives for artificial gas are electricity, wood, coal, oil and the residual products of crude oil.

Electricity, while fulfilling every expectation as a means of light and power, has never measured up to the standard of other means for producing heat. Heat generated by means of electric resistance can never be a successful competitor of gas where the materials from which gas is derived are readily obtainable. It is also conceded that the transporting cost of coal and oil from which gas is made, to the point of manufacture, is materially less per heat unit than the cost of conducting electric energy to the point of its conversion into heat. The use of electricity for heating therefore becomes at once an economic waste of material and man power. The same truth would apply to lighting except for the diversified uses of electric energy, its adaptability and the personal care that is necessary in the use of gas and oil.

The lack of a good quality of bituminous coal in California renders its use as a competitor of oil or gas at once out of consideration. When one considers the enormous amount of labor required in the mining, transportation and distribution of coal, and the lack of efficiency in its application to the production of heat, and the necessity for the removal of the residuals of combustion such as clinker and ash it is evident that it may be dismissed from this discussion. The chief consideration can safely be given to the relative merits of oil used directly and of oil transformed into artificial gas by the modern process which is essentially Californian in character.

In the modern process of gas manufacture from crude oil it is safe to estimate that not more than 7 gal. of oil is used, for all purposes, in the production of 1000 cu. ft. of gas having a thermal value of 550 B.t.u. per cu. ft., 70 per cent of which is applied to effective work in modern domestic appliances and more when used in large industrial installations. The distribution of gas requires no transportation or man power nor are these involved in the disposal of residual or by-products. It is available to the smallest consumer as well as the largest and has been a most important factor in war work.

The gas company in delivering gas to the consumer eliminates the coal bin, and provides hauling of material to any waste from the kitchen or factory. A much higher percentage of the total heating value is utilized than in any other form of fuel. The use of gas means conservation of man power, for all equipment is ready and manufacturers and industrials need not stop other important work to supply the needs of gas companies.

Oil-transmission lines deliver the material to the plants and men and transportation facilities are released for other work. Engineers, firemen, laborers, horses and wagons and the minor materials necessary in the operation of small steam plants can be dispensed with if gas is the fuel. Insurance rates are lower, for the fire hazard is reduced to a minimum.

Future Requirements of Oil

D. M. FOLSOM[2]

No one can measure with any degree of accuracy the quantity of oil under ground and no oil company can ever hope to secure in storage above ground more than a few months' supply of crude oil or any petroleum product. A change in the demand for refined products is immediately reflected in the entire industry. While it was rash to predict the future, the speaker said, he would attempt to point out in a broad way the future requirements of oil on the Pacific and particularly to emphasize the dependency of Pacific industry and commerce upon oil.

If the United States is to meet successfully the industrial and political problems which will arise after the war it must be done through increased domestic development and through the expansion of our foreign commerce. Furthermore, every boat that operates successfully on the Pacific under the American flag must be an oil burner, and eventually these boats will be equipped with internal-combustion Diesel engines. There are two reasons for this. In the first place the coaling stations of the world are under the control of either the English or Japanese nations, but more important than this is the fact that only through the use of oil can America meet the cost of competition under the handicap of the high wages which this country pays its seamen.

Oil is a natural fuel for ships: compared with coal it is cheaper, easier to handle, and more efficient in use. It gives a longer steaming radius to vessels. The amount of oil required to supply our new boats will tax our resources to the utmost. At present we are not producing in this country enough oil to meet our own domestic requirements and the present estimates of the Shipping Board call for an additional eighty million barrels, or 25 per cent of the present production, for the support of the new merchant fleet.

This can only mean one thing—a smaller quantity of oil for use on land. It is inconceivable to us as Americans that our fleet will not be a success, but we will be unable to compete successfully in the commerce of the world unless we provide oil for this fleet by conservation and substituting other fuel or power on land for the fuel oil we are now consuming.

On the Pacific Coast this presents an acute problem worthy of the best talent in the engineering profession. Oil is our best fuel, and California oil supplies two-thirds of the power, light and heat over the western third of the United States.

If we are to expand our own trade and develop products to supply cargoes for our ships, we must have fuel for factories, mines and farms. With the necessity for decreased use of oil, where is the Pacific Coast to get this power? I believe there is no single solution, but instead a joint solution to this problem. Oil must be used more efficiently both on land and on ships through the development and increased use of the internal combustion engines, and on land hydroelectric power must be developed and used on a greater scale than ever before.

Intelligent conservation means efficiency in the use of our fuel—not curtailment that cripples industry. Intelligent conservation also requires development of natural resources now utilized. Regardless of the cost in money or the labor involved, the streams of the Pacific slope must be made productive of power.

This program brings an opportunity to engineers—in fact it brings more than an opportunity—it is an obligation to each society of engineers and each individual to get out of the technical groove and to use imagination, to use initiative, and to think in terms of the future.

[1] Vice-President and General Manager, Pacific Gas and Electric Co.

[2] U. S. Fuel Administration, Oil Division.

Electric Consolidations and Their Relations to Fuel Conservation

H. G. BUTLER[1]

Since the beginning of the war the Government has gradually eliminated all the more conspicuous forms of waste, and it will be necessary to continue this policy after the war if we are to compete successfully with the industries of Europe, all of which have been speeded up for war production in such a way that the speed can be maintained after peace comes. In France, to cite only one instance, 180,500 hp. has been installed since 1914 on three rivers of the Alps. The magnitude of this development can be appreciated when it is understood that it would carry about 50 per cent of the peak load of all the power plants in the state of California north of Merced.

Production all hinges on power; power reduced to its simplest

[1] Power Administrator.

terms means one of two things, fuel or water. The first step in the program of this country, beyond all question, should be to harness the streams.

There has lately been a move all over the world to interconnect independent power plants in the same locality, and interconnection has been held forth as a panacea for many of the ills to which the electrical industry is heir. The fact that interconnections are being made throughout the United States and other countries indicates that the mutual savings of the interconnected companies are great. They would be much greater, however, if the diverse interests of each company were harmonized and the entire situation in any given territory were handled as a unit. For a supply of 500,000 kw. for war industries in the East it has been estimated that isolated plants, in comparison with central stations, require for installation twice the investment and for operation four times the coal, four times as many coal cars with their complement of locomotives, track and terminal facilities, and four times the man power. Again it has been estimated that if the whole of England were linked up with central stations located at economical points near the coal supplies 50,000,000 tons of coal per annum would be saved.

It is impracticable to attempt to show the actual savings which could be made in fuel by either interconnection or consolidation, because there are many unknown factors in each case and which vary from day to day. Broadly speaking, consolidation would conserve fuel in five ways:

1 It would improve the yearly load factor and the daily load factor because of the greater diversity of load, thus increasing the efficiency of the steam plants; instances of which are the consolidation or interconnection of two companies, one having a large lighting load in the winter and the other a large irrigation load in the summer, or of two companies, one having an industrial load and the other a street-railroad load.

2 In the case of companies having both water- and steam-power plants, the combined operation of water-power plants of different physical characteristics, as for instance a plant with natural stream flow but without storage and a plant with a large forebay, would permit the carrying of peak loads by water power which, without combination, would necessarily be handled to a large extent by steam by the company having the natural stream flow developments.

3 It would permit the load to be blocked out to the more efficient steam plants, so that the less efficient plants would operate only on the peaks or would shut down if the combination had excess generating capacity.

4 In making extensions the combined companies would install larger and more efficient units than the several constituent companies, if each company should make its own extension. In the larger plant higher-class boiler-room supervision would result in fuel economies.

5 Under consolidation existing plants would be enlarged and new plants would be built in locations better adapted to handle the consolidated load, thereby saving fuel through reduced line losses.

As a by-product of consolidation, the loads which could be safely allotted to a certain generating equipment are materially increased and it would be feasible to apply to regular service a large portion of that generating capacity of the companies which would be otherwise held in reserve, because the interconnected transmission lines would make the reserve capacity of any one division available for the whole consolidated system.

In several of these instances it is possible that the mutual benefit to the interconnected companies would lead them to operate their plants to effect these economies; but in many cases commercial, legal and other reasons would interpose objections to the use of the plants in this manner, which could be overcome only by consolidation.

The economies effected in the use of fuel are only one phase of the whole question of consolidation. Consolidation results in saving man power, in conserving capital and in reducing operating expenses; but perhaps after all the greatest gain would be found in the fact that under consolidation the problems which arise in the territory of the consolidated companies would be approached and solved with a mind single to giving the best service for the least cost. Consolidation does not necessarily mean government or state ownership. Until the means of transmission shall have been improved the problems of the electrical utilities in each locality must be solved locally, and in no section of the country is the industry of such magnitude that it cannot be organized and managed by private capital. So many of the motives which urge men to put forth the best that is in them are lost under government ownership that it should be resorted to only after everything else has been tried and has failed. Some way surely can be found to secure both the benefits of consolidation and of private enterprise. Possibly the ultimate solution of the matter will be found in some partnership arrangement whereby the state or nation will do more than regulate but less than own and operate the electric utilities.

Sources of Energy Supply

P. M. Downing[1]

The development of the art of transmitting electric energy long distances has made possible the development of many water powers remote from suitable manufactures or railroad centers, and has been of particular importance in California where there is an abundance of potential water power and a dearth of fuel.

Water-power development in this state has been about equally divided between the northern and southern portions. In 1900 the aggregate installed capacity of all of the plants in the northern part was approximately 15,000 kw. In 18 years this has increased to over 375,000 kw., or at the rate of over 20,000 kw. per year. In addition to this there are also installed steam-generating plants having an aggregate capacity of approximately 187,500 kw., and yet with all of this development California is today facing one of the most serious power shortages in its history. In 1917 the five large power companies in the northern part of the state generated 1,507,000,000 kw-hr. Approximately 16 per cent of this was produced on steam, requiring 1,195,000 bbl. of oil. The peak load during the year was 265,000 kw. The load, both energy and peak demand, is increasing at the rate of 10 per cent per year. To meet this increase there will have to be provided each year additional facilities having an energy-producing capacity of not less than 150,000,000 kw-hr. and a peak capacity of not less than 26,500 kw.

The winter of 1917-18 was one of abnormally low precipitation. Without the usual late storms during the past spring, the stream flows during recent months have established new minimums. The steam plants which heretofore have always been considered as reserves to be used only in emergencies, have been called upon to operate up to their maximum capacity throughout the entire 24 hours of the day. During the past few months approximately 40 per cent of the energy supplied in the northern part of the state has been produced on steam, 40 per cent from stored water, and 20 per cent from natural stream flows.

A forecast of the future is not so bright. The only additional energy that will be available other than that due to a more nearly normal season, is 60,000,000 kw-hr. from the systems of the California Oregon Power Co. and the Northern California Power Co., and an additional 75,000,000 to 100,000,000 kw-hr. from the increased steam plants of the Pacific Gas & Electric Co. On the basis of an annual increase in load amounting to 150,000,000 kw.-hr., this additional energy, even with normal water conditions, will hardly be sufficient to carry the load through the year 1919.

Unless other facilities are obtainable by 1920 there will be a more serious shortage beginning with that year, which will be cumulative until other facilities are provided. No new hydro developments are under way at the present time, and in view of the scarcity of labor and material no new installation of any size can be made in less than two years. Without additional hydroelectric power to relieve the situation, there will be required for steam generation by 1920 between 3,000,000 and 3,500,000 bbl. of fuel oil—an increase of between 500,000 and 700,000 bbl. per year.

[1] Chief Engineer Electrical Department, Pacific Gas & Electric Co.

District Steam Heating as Related to Fuel Conservation

H. S. Markey[1]

District steam heating affords a means for the conservation of fuel. The records of district steam heating over an area of approximately 56 city blocks in the business, hotel and apartment-house districts of San Francisco, and operated in conjunction with a main steam-electric generating station, show, for example, a considerable saving.

The steam is supplied from two well-equipped and efficiently-operated central stations and is delivered through underground pipes. Such a system should be economical in the use of fuel oil, especially if turbo-generators are interposed between the boilers and the consumers, because electric energy so generated reduces the load on the main steam-electric generating stations.

The fuel burned in the stations during the twelve months ending with August 31, 1918, amounted to 129,893 bbl. Maximum and minimum months were January (16,043 bbl.) and August (7102 bbl.).

During the same twelve months the stations produced 6,411,990 kw-hr. Maximum and minimum months were January (947,030 kw-hr.) and August (319,590 kw-hr.). In addition to the electric energy some power is developed in a pair of large steam-driven elevator pumps, but as this power would have to be estimated, no account is taken of it in the records. A comparatively small number of consumers who are not within reach of the exhaust mains are served from a high-pressure main with steam direct from the boilers.

Because of the electricity generated the district steam system is credited with fuel, the exact amount of which can be determined only from thermodynamic considerations. An allowance which is practically correct can be made as follows: The use of steam turbines in the line increases the fuel consumption by 8 per cent or 10,340 bbl. per year. The main station generates from 80 to 240 kw-hr. per barrel, depending on the load, the average for the twelve months being 195.2. The electricity generated at the steam stations, therefore, reduced the year's consumption of fuel at the main station by 32,900 barrels. The difference, 22,510 barrels, was actually saved. This amounts to one barrel for each 285 kw-hr. generated at the steam stations. The high efficiency of the steam-heat stations is due, of course, to the fact that the heat contained in the exhaust from the turbines is not rejected to a condenser or the atmosphere.

The steam-heat stations are therefore to be credited with 22,510 bbl. for the 12-month period, 3325 bbl. for January and 1120 bbl. for August, leaving 107,383, 12,718 and 5982 bbl. chargeable to steam heat for the year, for January and for August, respectively.

The steam delivered to consumers is all metered with the exception of about 5 per cent, which is used in open-jet apparatus and which must be estimated for each consumer using such apparatus. This estimated quantity is added to the registration of the consumer's meter each month. Including the open-jet steam there was delivered to the consumers during the 12-month period 306,978,000 lb. of steam, and during January and August 41,609,000 lb. and 14,914,000 lb. respectively.

The steam is supplied to the consumers at an average pressure of 5 lb., and by the steam tables each pound carries 1156 heat units above 32 deg. fahr. The condensate leaves the premises at a temperature of from 100 deg. to 180 deg. fahr. above 32 deg. To get an even figure assume 156 deg. as an average. Then each pound of steam passing through the premises leaves behind it 1000 heat units. This is the difference between heat put in and heat rejected and is therefore the useful heat delivered to the consumer.

The useful heat delivered to the consumer per barrel of fuel, works out as follows:

For the 12-month period......... 2,860,000 units
For January..................... 3,270,000 units
For August...................... 2,500,000 units

Assuming 6,000,000 units as the heat value of a barrel of oil, the overall efficiency is:

For 12 months..................... 48 per cent
For January....................... 55 per cent
For August........................ 42 per cent

The variation in the demand for steam is such that for three or four months the larger of the steam-heat stations is not operated and for about two months during the winter both are needed. This condition affects the efficiency unfavorably.

Fuel would be still further conserved if there were twice as many consumers connected to this system so that its efficiency would be maintained the year round. During the winter peaks additional steam could be supplied direct from boilers held in reserve for that purpose. The amount of fuel burned under these boilers for a month or two would be small compared to the saving effected at the main steam-electric generating stations in a year.

[1] Engineer, City Electric Co., San Francisco.

Railroad Electrification as a Fuel-Conservation Measure

W. J. Davis, Jr.[1]

In making a study of the possibilities of conserving our available supply of fuel through the electrification of the railroad systems of the United States, there are two points from which the subject may be viewed:

1 The possible saving that may be effected by the replacement of the steam-locomotive equipment now in use with electric locomotives supplied with power from modern steam-electric generating plants of large capacity, suitably located with regard to cheap fuel and water and distributing over large areas through high-voltage transmission systems.

2 Saving to be expected by comparing the possible performances of modern compound steam locomotives using high superheat with a system of electrification and power supply as above described.

Basing calculations on pre-war conditions, it is found from the Reports of the Interstate Commerce Commission that the total gross ton-mileage movements of the railroads in the United States for the year 1914 were approximately as follows:

	Ton-Miles	Per Cent of Total
1 Bituminous coal	166,400,000,000	15.93
2 Anthracite coal	38,200,000,000	3.66
3 Railway-company coal	57,600,000,000	5.51
4 Miscellaneous freight	372,040,000,000	35.65
5 Locomotives	148,200,000,000	14.20
6 Locomotive tenders	74,630,000,000	7.15
7 Passenger cars	186,890,000,000	17.90
Total	1,043,960,000,000	100.00

In estimating the gross freight-ton mileage it has been assumed that the net ton-mile movement of the freight alone will be approximately equal to that of the cars. This assumption applies of course only to the first four items.

Assuming that the complete electrification of the railroads is feasible and desirable, it is at once apparent that a considerable saving may be made in the total ton-mileage shown above. In the third item of the table, railway-company coal, the ton-mile movement may be reduced to about one-third by the greater economy of electric power generation and a still further reduction will follow due to the location of many of the central power plants near the mines and to the use of such hydroelectric power as may be available. It would appear fair to assume, therefore, that the ton-mileage now required for the movement of railway company coal may be reduced to about 25 per cent of item 3, or 14,400,000,000 ton-miles. The saving in this item would be approximately 43,200,000,000 ton-miles or 4.15 per cent of the total.

[1] Engineer, General Electric Co., San Francisco.

The sixth item, ton-mile movement of locomotive tenders, may be eliminated completely, making a possible reduction of 74,630,000,000 ton-miles or 7.15 per cent of the total by the use of electric locomotives. We therefore find that the total ton-mile movement of all of the railroads in the year 1914 would have been approximately 926,130,000,000 if all of the roads were electrified, a saving of 11 per cent.

In estimating the fuel consumption of the electric power plants required for the above movement, we can take as a basis for our calculations the results of some tests made on the Chicago, Milwaukee & Puget Sound Railroad, between Three Forks and Colorado Junction. The net energy consumption in a round trip over this section of heavy grades and curvature, using regenerative braking, was 23.75 watt-hours per ton-mile at the locomotive, including power required for all of the auxiliary apparatus. The energy consumption of the same train on level track of the same curvature as determined from the known train weights, profile and locomotive efficiency, was found to be 20.4 watt-hours per ton-mile. These results are of particular interest as they show that with electric locomotives and regenerative braking it is possible to eliminate a large proportion of mountain grades in so far as they affect the power required for moving the trains.

It will be seen from the above that highly efficient compound non-condensing steam locomotives of modern type operating in railway service as it exists today would be expected to use more than 2.5 times as much fuel as is required by an equivalent electric system. If we assume the total fuel requirements of the two systems to be in the ratio of the estimated economies shown above with allowance for reduced ton-mileage of items 3 and 6 in the ton-mileage table, the saving in fuel on this basis for 1914 would be 79,400,000 tons.

In our final consideration of the possibilities of fuel conservation by electrification of the railroads, we must not overlook the fact that in large steam-power plants it is feasible and often economical to burn low-grade coals, whereas the steam locomotives require the higher grades of selected lump coal. This will release a large part of our highest-grade fuel which may be applied to our growing merchant-marine demands and to household uses.

Assuming a transmission efficiency of 72 per cent from the power-station bus bars to the collectors of the locomotive, the energy consumption at the power house, using the larger test result as a basis for calculations, is found to be 33 watt-hours per ton-mile.

Assuming then a total ton-mile movement of 926,130,000,000, the energy consumption required by complete electrification would be 30,500,000,000 kw-hr., to which should be added 20 per cent for shifting and yard movements and additional requirements of suburban passenger service, making 36,600,000,000 kw-hr. as the total energy consumption for the completely electrified system. On the basis of an operating economy of 1.84 lb. of coal per kw-hr., the annual fuel requirements for electrification would be 33,700,000 tons of coal. As the actual amount of coal consumed by the railroads in 1914 for locomotive use alone, including an allowance for fuel oil on the basis of 4 bbl. of oil per ton of coal, has been found to be approximately 120,000,000 tons, the total saving to be expected in case of complete electrification would be 86,300,000 tons. This is about one-sixth of the total coal production of the United States.

The point may be raised that the above calculations are hardly fair to the steam locomotive as we are comparing a highly efficient modern electric-generating system with a variety of steam locomotives, many of them of old and inefficient types, and that modern compound steam locomotives using high steam pressures and high superheats might accomplish almost as great a saving as would be obtained by electric haulage. That this can not be true is due to a number of factors inherent to the two systems. The effect of these factors may be seen from the following tabulated calculations in which the economy of a large turbo-generator station operating under steam conditions demonstrated to be

(*Concluded on page 292*)

DAVID MOFFAT MYERS ON FUEL CONSERVATION

At the Refrigeration Session of the Annual Meeting in December, David Moffat Myers, Advisory Engineer of the U. S. Fuel Administration, discussed in a brief address the engineer's part in carrying out the object of the United States Fuel Administration, which was to obtain the fuel required for conducting the war. He said when he went to Washington a year earlier he found that the only kind of conservation practiced was saving by curtailment. When, however, the four national engineering societies had appointed a committee, of which Professor Breckenridge was chairman, that coöperated with the Bureau of Mines and some officers of the Fuel Administration, a plan of action was adopted which solved the problem of fuel shortage with least inconvenience to all concerned. The guiding motive was "maximum production with minimum waste." Instead of saving coal by shutting down factories, they were kept going at higher efficiency, so that a saving of 10 to 25 per cent was made in their coal consumption, a saving which, during the first six months of this program, starting May 1, 1918, was equivalent to 7,000,000 tons of coal per annum from the power plants alone, plus 5,000,000 tons saved in other directions.

During 1918 a force of 1500 volunteer engineers, including a large representation of The American Society of Mechanical Engineers, gave their efforts to the work of inspecting and advising power-plant operators in the economical generation of steam and power. The demand for coal increased so rapidly during the war that by the end of 1918 the United States would have produced and distributed 100,000,000 tons of coal more than during the year 1916.

Mr. Myers then described how the Fuel Administration proceeded to enlist the coöperation of industrial plants. It was recognized that during the war there was little opportunity for improving the existing equipment of plants, but it was entirely feasible by education to impress upon the operators the necessity for fuel conservation and the means available for effecting it. In addition to personal visits by the representatives of the Fuel Administration, lectures were arranged to reach a large audience. At such lectures a number of lantern slides were made use of, which served to bring out in a simple manner the several fundamental rules to be observed in the economical operation of steam and power plants. Reports received at Washington served to prove that the entire campaign was very successful in both small and large power plants. These slides were also exhibited at this meeting and explained by Mr. Myers.

The speaker further related how in the beginning of the work failure had been predicted because of the attempt of the fuel engineers to go into a man's plant with the intention of telling him what to do. It was decried as paternalism. But the results showed that with the possible exception of one, all of the states endorsed the procedure of the administrative engineers; and directly after the signing of the armistice, when there was talk of the dissolution of the Fuel Administration, requests poured in from all parts of the country to continue the good work. In reply to these requests a conference was held early in December 1918, attended by Van. H. Manning, Director of the United States Bureau of Mines, Dr. Otis Smith, Director of the United States Geological Survey, and Dr. H. A. Garfield, United States Fuel Administrator, at which it was decided to merge some departments of the Fuel Administration into the other two Government departments named. For example, the work of the Conservation Bureau as well as the engineering program would be taken over by the Bureau of Mines. In conclusion Mr. Myers asked the engineers present to continue to loyally support the conservation movement until the new organization was ready to relieve them of this work.

At this session, which was held jointly with the American Society of Refrigerating Engineers and presided over by Dr. D. S. Jacobus, two papers were also presented: namely, The Development of a Standard Refrigerator Car, by Dr. Mary E. Pennington, of the Food Research Laboratory, U. S. Department of Agriculture; and Refrigerating Plant Efficiency, by Victor J. Azbe.

Chairman Jacobus in opening the discussion inquired of Mr. Myers whether in his opinion the excellent results achieved in war time were likely to continue after peace had been declared, when one of the actuating motives, namely, patriotism, would not be as strong as during the war. He further would like to know whether, in Mr. Myers' opinion, the power given the Fuel Administration to cut off the fuel supply in case there was undue waste, which was not corrected, had any important influence. Mr. Myers responded that in no case had it become necessary to actually cut off the supply because the idea of conservation had met with widespread favor, and he believed that the good results would be likely to continue if means were provided for properly carrying on the movement after the war.

plant with the object of improving it to earn a fee. From the speaker's sad experience he feared that hereafter the operating engineer, especially in a small plant, would have the same difficulty as formerly in convincing the management that he should be supplied with the equipment and instruments required for economical operation.

Joseph Harrington, Fuel Administrative Engineer for Illinois, at the suggestion of Harold Almert, described a chemical method of removing soot from boiler tubes which, he declared, was very effective. It consisted simply in throwing coarse salt upon the incandescent bed of clean fuel once every day. This would fill the furnace with dense white fumes, chlorine gas, which would attack and loosen the soot, whether it was a boiler or a domestic furnace.

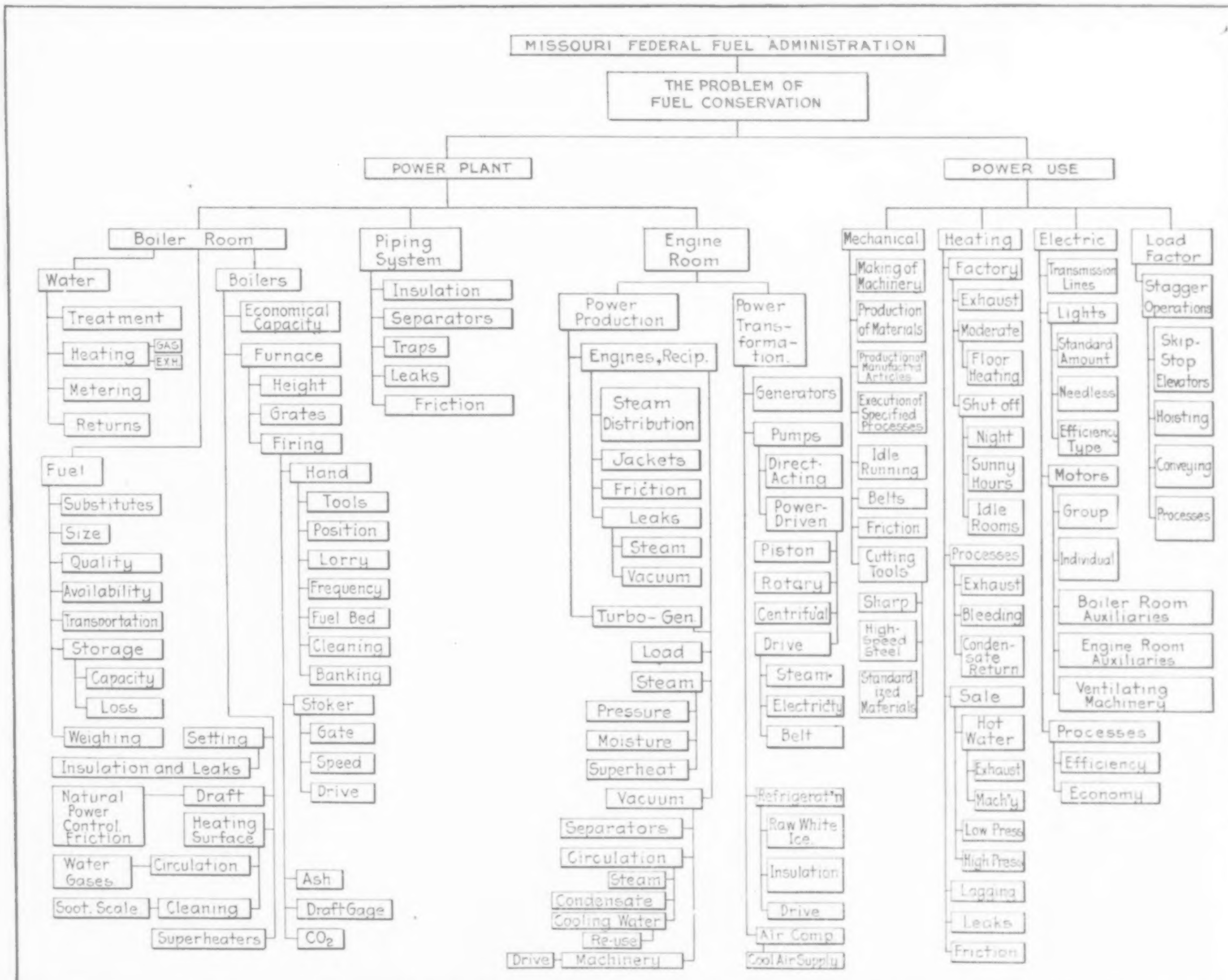

FIG. 1 PROBLEM CHART USED BY FUEL ADMINISTRATION IN MISSOURI

Edward N. Trump thought it a good plan to have every plant in the country fill out the questionnaires and have the statistics thus obtained tabulated; the Bureau of Mines could then step in where required and encourage the saving of fuel.

Edgar G. Scott felt that a great deal of the success of the fuel-conservation plan was due to the fact that it reached the owners and managers of plants who ordinarily paid little attention to their cost of power because it represented only a small percentage of the cost of doing business. No doubt the presidents of companies realized that the best engineering skill was behind the questionnaires, and that the force of the national engineering societies supported the cause. Hence their attitude was more friendly than in the case of a single engineer coming into their

and whether hard or soft coal was burned. The soot greatly interfered with the rapid transmission of heat, and it was therefore important to remove this obstacle to fuel economy. A pound or two applied once or twice a week would keep a domestic furnace in good condition. In the case of a 300-hp. Stirling boiler, equipped with Green chain grate, burning Illinois coal, five ordinary coal scoops of salt were being introduced, one at a time. It took about half an hour for each scoopful to disappear. It might take half a day to thus clean a dirty boiler, but if this treatment was applied every day or two, the boiler would always be clean. After two years no sign of corrosion or deterioration of the brickwork would be detected.

Mr. Myers estimated from the results of an accurate test made

two years ago on a 5000-hp. boiler installation in a steel mill that even with the periodical manual removal of soot once every three days, the soot increased the coal consumption on the average by 6 per cent.

THE FUEL ADMINISTRATION IN MISSOURI

THE very thorough manner in which the work of the Fuel Administration, outlined above by Mr. David Moffat Myers, has been conducted in the various states and districts throughout the country, is well illustrated by the following account of the Fuel Administration movement as carried out in Missouri and particularly in one district of that state. The information was supplied through the courtesy of Prof. H. Wade Hibbard,[1] Mem. Am.Soc.M.E., District Engineer in the Fuel Administration of Missouri. Accompanying it were the problem chart shown in Fig. 1 (p. 270) and the district organization chart shown in Fig. 2. These were presented by Professor Hibbard at an early fall meeting of the state and district officers of the Coal Conservation Section of the Fuel Administration.

Organization and Conditions in the State

The work of fuel conservation in power plants and factories was being successfully carried out over a very large area of the United States in the second year of the war. The Coal Conservation Section of the United States Fuel Administration, although centrally administered, permitted autonomy as regards organization within the different states. The centralization or distribution of power plants in a state, its topographical divisions, the availability and concentration of Engineers suited for the work—all had their influence in determining the form of a state's organization.

In Missouri the State Administrative Engineer is Mr. J. A. Whitlow, Mem.Am.Soc.M.E., an engineer in the Public Service Commission which patriotically permitted him to devote his entire time to this work. His office was already located in Jefferson City, the capital, and at the geographical center of the state. Under him there are eleven District Engineers, each also already located within his district, and serving without pay.

The state is almost square, measuring 314 miles by 353 miles. It has two large manufacturing cities, St. Louis and Kansas City, respectively, in its extreme east and west, with many small cities scattered over its rich agricultural northern half, separated by the great barrier of the Missouri River from a more sparsely settled southern half, broken up by the Ozark mountain region. In the southwest there is a populous mining district and along the Mississippi and Missouri Rivers are numerous cities of moderate size. These features indicated a suitable division of the state, and also produced variations of organization among the Districts.

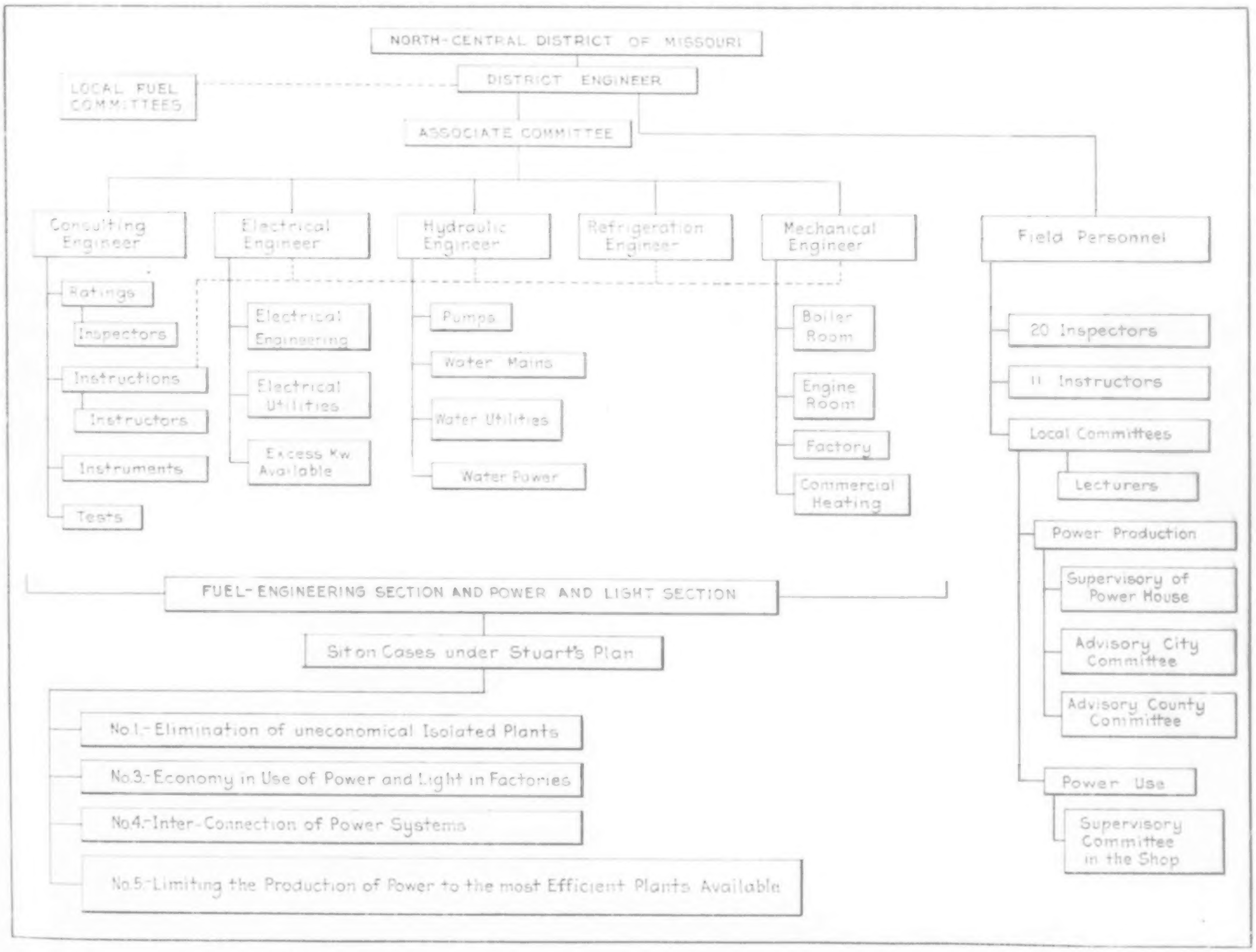

Fig. 2 Organization Chart Used by Fuel Administration in Missouri

Problem Chart

The purpose of this chart (Fig. 1) is to show in classified graphical form the items in power plant and factory affecting the use of coal, with their interrelationships. The chart serves as a guide to office and field work, and eventually would have

[1] Prof. Mech. Engrg., University of Missouri, Columbia, Mo.

been placed in the hands of every inspector and instructor, and posted in each power house and factory.

In its Power Plant Section this chart bears some resemblance to that used by a power-plant designer, but it will be noticed that a great number of items are omitted which such a designer would use. His need is for a statement of the inter-relations of every piece of machinery, equipment and apparatus which by any possibility could enter into his design, while this chart considers that subject purely from the viewpoint of coal saving.

A similar comment should be made regarding the Power Use Section. Naturally the details of every industry could not be included in such a published chart, but only the more general features common to a large number of industries in the state. The Committee on Power Use, mentioned in the Organization Chart in Fig. 2 as in each factory, would work out the additional items for its own chart along the lines suggested here. This local work would be under the help and guidance of the visiting instructor and the engineers of the Fuel Administration.

Organization Chart

The chart in Fig. 2 gives the organization as developed in the district of which Professor Hibbard had charge. The office was at Columbia, thus permitting the use of the volunteer work of a number of men connected with the School of Engineering and the power plant of the University. The local fuel committees had been previously appointed by the state fuel administration, headed by Lieutenant-Governor Crossley, and were at the county seats which are the chief centers of population and industry in the eighteen counties of the district. These committees had charge of fuel requirements, production and distribution, and were naturally closely interested in this work of fuel conservation.

Quite different from the practice followed in some neighboring states, this district made use of inspectors and instructors living in different parts of the district. In the summer of 1918 the District Engineer visited every important power plant, and from their chief engineers selected the best for his purpose. Several men were traveling engineers of pumping stations for oil pipe lines or connected with railways. Some were general managers of power plants with engineering education. Where desirable, employers were interviewed and gave hearty and patriotic consent that their subordinates should devote part time to this work. In a district where the power plants are scattered over an area of 140 by 133 miles, it seemed impossible to carry on this work of inspection and instruction thoroughly and efficiently by men located in one city, even though the men were available, as they were not. As the work was entirely without salary the men could not be expected to be away from home for considerable periods.

Large-scale maps were used showing each man's territory, cities and their data, with railroads and time tables and some automobile routes; charts with power plants under each man, with dates of assignments and visits; 10 by 12 card indexes of each town and its factories, with all names, facts, characteristics and other desirable data; maps for routing of lecturers and films; "tickler" indexes for keeping track of the work; and other time-saving devices familiar to the organizing and management engineer.

Under Field Personnel and Local Committees in Fig. 2 will be noticed the Advisory City Committee. These committees are made up of owners and chief engineers of all the plants in the city, with the leading chief engineer as chairman, unless an inspector or instructor resides there. Local enthusiasm is thus intensified, and the smaller chief engineers get the benefit of advice from their more expert associates.

"Send a Miner Substitute to Pershing" was the slogan adopted and spread among all the power plants of the district. They all knew that the general was born at Laclede in the district. In the Civil War a drafted man could send a substitute in his place. In the present war men beyond draft age, or rejected or deferred because indispensable, were as intensely patriotic as those who went. They enthusiastically took up the slogan in fuel conservation. Any man who was the means of saving one coal-miner's annual output thereby released that man to carry a rifle in France or drive a ship rivet or make a shell. So if owners and engineers and firemen and shopmen could send their "miner substitutes" to establish freedom and liberty in the world, they were exceedingly glad to do so. Coöperation with the Fuel Administration became an easy task; they were not only waiting but aching "to be shown" how they could help.

Those whose hearts have been in this conservation work of the United States Fuel Administration hope that this most widespread university or engineering-extension scheme will in some form be continued by the Government, that the new efficiency, the management engineering in power plants, may carry on its far-reaching education and save human effort in a fundamental industry supporting all the industries.

CORRESPONDENCE

Contributions to the Correspondence Departments of Mechanical Engineering by members of The American Society of Mechanical Engineers are solicited by the Publication Committee. Contributions particularly welcomed are suggestions on Society Affairs, discussions of papers published in this journal, or brief articles of current interest to mechanical engineers.

Proposed Modified Form of Screw Thread as an International Standard

To the Editor:

Numerous commentaries have been written upon the advantages of standardization of engineering productions for use in this country. Now the theme has grown, until today the topic is International Standardization and the question becomes one involving consideration of manufacture in all countries; also of what changes may be made without disrupting business.

Those versed in screw-thread matters have from time to time expressed themselves regarding the shortcomings of the Sellers or U. S. Standard form of thread, particularly in the finer pitches. Among those that have so expressed themselves are Messrs. L. D. Burlingame, Ellwood Burdsall, E. H. Ehrman, F. O. Wells and E. T. Bysshe. The consensus of opinion has been that the crests and roots of screw threads should be flatted to a greater extent than in the U. S. standard thread.

Suggestions have been made for a thread form flatted more than the U. S. Standard thread which might serve as a basis for an international standardized screw thread. Figs. 1 and 2 show respectively the suggestions of Mr. Burdsall and of Messrs. Bysshe and Ehrman.

The diagrams suggested are basic and do not include such details as crest or root clearance, depth of engagement, etc. They lend themselves well, however, to the application of liberal clearance and tolerance without reducing the depth of engagement below that in some of the existing standard profiles.

Assuming a standard pitch, it appears that the following conditions must be met:

A standard thread profile must be

1 No greater in depth than the shallowest existing thread
2 Equal or greater in depth of engagement than the least depth obtainable in any of the existing threads
3 With crest or root clearance sufficient to provide for tool wear in manufacture, and for service

4 Equal to or better than existing profiles in withstanding mistreatment
5 Such as to permit a latitude in the shape of the tool crest
6 No more difficult of production in respect to tools, gages, or product than in any of the present systems
7 With pitch diameter no less than any existing thread profile
8 With elements of thread profile the same; or if there are differences they must be within the commercial tolerance allowed, if internationalism is to be considered
9 With strength of screw equal to or greater than in prevailing systems.

Having in view these axioms, we must consider the principal systems now in use. There are the U. S. Standard and Whitworth systems, both of which have admitted disadvantages, of which the following are the most prominent:

a U. S. S. Root: This is admitted to be too narrow, especially in the finer pitches, and the truncation triangle too small (1) to secure a stable crest in the tool, or (2) to obtain adequate root clearance in the product.

b Whitworth Crest: The depth of engagement is needlessly reduced by at least 0.9 of the height of the rounded crest.

c Whitworth Crest: The apparent advantage of the rounded crest to withstand marring in handling is offset by the difficulty (1) to accurately produce it in the tool and gage, and in the product; (2) to vary it sufficiently to provide adequate clearance, or even necessary tolerance without reducing the depth of thread bearing in a greater ratio.

d Whitworth Angle: An angle of 55 deg. is more difficult to reproduce than the U. S. S. 60-deg. angle.

e U. S. S. Crest: While this crest may not hold its theoretical shape in the tool as well as does the Whitworth crest, the cause may not be due entirely to profile; in all probability it is due partly to its relative narrowness. On the other hand its production, both in the tool product and the gage, is attained and maintained with much greater facility than is the shape of the Whitworth crest.

The modified form of thread suggested by Mr. Burdsall has an increased area of 17, 19 and 24 per cent, respectively, for ¼-in., ⅜-in. and ½-in. bolts, and under test has shown an increased strength at root varying between 11 and 12 per cent. None of these bolts failed by stripping.

The form of screw thread used on the well-known Liberty engine furnishes an excellent example of the possibilities and advantages that are to be gained through a greater truncation than that which obtains in the U. S. Standard thread.

At a meeting of the Gage Committee of the British Engineering Standards Association in September, 1917, a modified form of thread was proposed having the thread truncated slightly at the crest and slightly deepened at the root, the angle of thread and the effective diameter to remain the same. Arrangements were made with a few manufacturers to make sample screws of this modified form of different metals and forward a report.

Owing to the fact that the British manufacturers were then in the stress of high production, a thorough trial was not possible, and the Committee, as a result of the reports received, made the following recommendations:

It was considered undesirable to recommend to the Designs Department the adoption of this flattened form of thread as a compulsory measure, but that tolerance of large amount might be given at crest and root. (See C. L. 4102, British Engineering Standards Association.)

All authorities have agreed that the condition governing the fit of a screw is that the engagement must be as much as possible on the side of the thread, and that the crest and root must clear.

Experience has shown that the sharp "V" thread is impossible to produce because the point of the tool wears so rapidly, producing a screw which will only interchange with difficulty.

The U. S. Standard and Whitworth threads are modifications of the sharp "V" and overcame the low-production manufacturing difficulties of the day now past.

In this communication it has been shown that engineers in widely separated localities have developed independently the same idea, and the feasibility of the features mentioned has been demonstrated by the Liberty engine. Therefore, is it not possible that the proposed modified screw thread contains the fundamental characteristics for modern large-production manufacture and for international agreement?

Great progress in individual standardization of screw threads has been made by the manufacturing countries of the world, but the master mind always considers the future and introduces these questions:

1 Has the best form of screw thread been adopted?
2 When definitely promulgating standards, should other manufacturing countries be considered?
3 After the recent stress of high production, can we complacently look on and consider the science of perfectly manufacturing screws to be thoroughly understood, and further progress impossible?

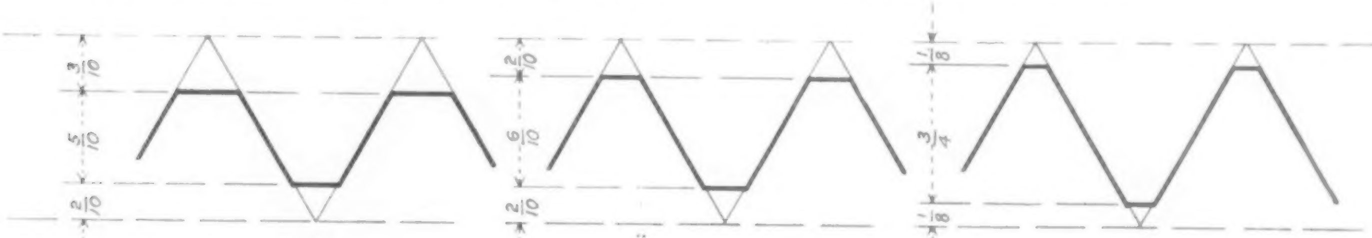

FIG. 1. Suggested by E. Burdsall.

FIG. 2. Suggested by Ernest T. Bysshe and Edwin H Ehrman.

FIG. 3. U.S. Standard. Present.

It seems illogical to suppose that the modern engineer will answer affirmatively to the first and third questions.

The National Screw Thread Commission is about to publish a tentative report, with recommendations on Screw Thread Form, Pitches, Classification and Gaging. This report considers only the form of thread in use in the United States, but since it is but a tentative report, the merits of a modified form of thread may be considered, and the door to international standardization not be closed.

Robt. Lacy,
Lieut. Engrs., U. S. A.

Washington, D. C.

Marine Practice in Valves and Fittings

To the Editor:

Professor Christie's paper in Mechanical Engineering for February, on the state of shipbuilding standards, is particularly opportune, coming at a time when the experiences of manufacturers and shipbuilders alike have pointed out the great hindrance to production occasioned by insufficiently or improperly standardized equipment.

Standards. About three years ago the writer questioned an experienced naval constructor as to why the A. S. M. E. standards in flanges and fittings had never been adopted by the Navy, and was informed that the requirements necessitated the use of stronger materials in order to cut down the weights. This would indicate a tendency to ultra-conservatism among shipbuilders rather than dependence on facts and logic.

The weight of piping in a ship probably never reaches five per

cent of the total weight, and any increase in weight due to the adoption of standard dimensions and materials would be measurable in hundredths of a per cent. A striking example of the need for standards is found in the case of brass and copper tubing. Almost without exception in the trade, brass and copper tubing is made in standard O. D. sizes, yet shipbuilding orders are for the most part specified by I. D. sizes; and the writer has found the use of 12 or 13 different gages on *each size* of tubing between $1\frac{1}{2}$ in. I. D. and 5 in. I. D. Such a condition is not merely uneconomical; it is ridiculous. Many times orders from the same yard differ by one or two thousandths of an inch for the same I. D. sizes, and in many cases the gage is expressed in ten-thousandths. Very likely this last is chiefly due to some conscientious but recent technical graduate. No doubt there is good reason to save money on this expensive material by keeping down thickness, but certainly three to four gages in each size would entirely cover the requirements, especially since the stresses involved in piping under temperature variations are so nearly indeterminate. Most of the failures in piping have been due, not to bursting stress, but to abuse in erection, water hammer, and insufficient provision for expansion.

The objections to copper piping are the expense, both for material and fabrication; low tensile strength; and unsuitability for superheat. Steel piping meets these requirements much better, the sole objection to it being possibility of quicker corrosion. The corrosion from the steam side is of no more importance than in land practice, however, and the exterior corrosion, as Professor Christie suggests, should be cared for by suitable painting. Properly covered pipe should be safe from external corrosion, provided the covering is kept unbroken (particularly around joints) and well painted. The covering presents a considerable resistance to the flow of salt water along the outside of the pipe, and if the pipe has a fairly high temperature there is little or no danger of any liquid ever reaching the pipe itself, as at the slow rate of absorption the liquid is evaporated before it can reach the metal.

Expansion. More reliable provision for expansion can be made in a material of high elastic limit like steel than in copper, as indicated by experience with corrugated copper expansion joints of multiple bellows type.

These joints have not been treated as *springs*. They are deformed by the movement beyond the elastic limit, and dependence is placed on the ductility of the material to withstand such heroic treatment. This statement can be readily proved by compressing a copper joint to its full rated capacity; it will not return to the original face-to-face dimensions.

The consequence of this has been that the weakest convolution takes most of the bending, resulting in a fracture. This condition has been partly avoided and the life of the joint increased by adding spacing rings inside and outside the corrugations, limiting the movement of any individual corrugation, and more or less equalizing the deformations. If this type of joint were made of steel and treated as a spring, with no deformation exceeding the elastic limit, no trouble should be experienced. The success of this joint has been successfully proven by an English company manufacturing corrugated-steel barrels, which has brought out a perfectly satisfactory steel joint without spacers. An Australian (Beiliez) company has also developed a process for making corrugated pipe either in straight lengths or bends, which has from 15 to 20 times the flexibility of uncorrugated bends. We therefore have available suitable means for taking care of expansion without resorting to packed expansion joints of the slip type.

Piping. The enormous and successful use in land practice of the lap or Van Stone joint, and also of the welded header-and-line joint casts a doubt upon the wisdom of excluding them from marine work.

No tests have been published showing any well-grounded reason why these devices cannot be successfully used for marine work. One of the particularly advantageous features of the lap joint for marine work is the loose flange and consequent ease of alignment of bolt holes.

The tendency in land practice is to increase the use of welded work, and the writer has expressed the opinion that for extreme pressures and temperatures welding should be universal.

Valves and Fittings. The writer believes in strict specifications for the material for high-pressure steam valves. Cast steel should be used for all high-pressure steam work; the use of semi-steel is unsafe, as the mixtures are unreliable. It would be better to encourage the development of a cheaper steel casting than this hybrid material of uncertain characteristics.

The writer's practice on high-pressure work is to use flanged joints on everything of 3 in. and over; on low-pressure work (except for drainage piping under very light pressure) flanged joints on 4 in. and over. No trouble has been experienced with the smaller screwed work.

The use of gate valves should by all means be encouraged; for all line purposes they are as tight as globe valves and of course much reduce friction loss. For throttles and stop valves the globe or angle type will necessarily be retained.

Flanges. The writer does not feel that the revival of six-hole flanges in the small sizes noted by Professor Christie is either necessary or desirable. The stresses involved for all sizes under the A. S. M. E. standards were figured from the same basis; consequently there is no excuse for a change on that ground. But the six-hole flange permits of only two positions of a standard drilled fitting, whereas the four-hole drilling permits of four. This is of very considerable value if field or special drilling is to be avoided.

Another desirable consideration in favor of the purchase of standard accessories such as reducing valves and relief valves, is that the makers of these devices are doing nothing else, and are selling the goods on their merits. The designs are therefore more likely to be satisfactory than where produced by marine designers to whom they are only an occasional undertaking.

The lavish use of brass and copper pipe could probably be much reduced without any decrease in reliability. For instance, brass pipe is now much less used for boiler-feed lines, except for the short section between the feed-regulating valve and the boiler drum.

Another cause which enormously restricted the output of the tube mills was the requirements for condenser tubes. The Government and consequently the shipyards maintained for over two years three inspection tests of such tubes that were incompatible, and in fact that forced the manufacturers to make a tube that was not desirable. The three tests were the hammer, pin and compression tests. The hammer test (crushing the tube flat to three times gage overall) and the pin test (expanding $16\frac{2}{3}$ per cent in diameter) would be satisfactory if a soft tube were furnished. But the compression test (loading with definite weights across the tube and limiting the permanent set) requires a hard tube which in view of the season certain to occur is very undesirable. The reason for its adoption was ostensibly to guard against crushing by packing too tightly with the corset lacing.

As a matter of fact, a hard tube can be crushed by abuse in packing as well as a soft tube, and further, corset lacing was abandoned years ago by up-to-date power-plant operators for fiber ferrules, which are a better material and with which it is difficult to crush any tube. The hard tube is certain to cause trouble if expanded into the tube sheets (as in the destroyers), yet it required two years' effort to get the compression-test limits raised from 0.005 to 0.020. With regard to both condenser tube and all other brass and copper tube the Society would confer a lasting benefit, increase tube capacity, and decrease cost, by standardizing the sizes and specifications.

R. J. S. PIGOTT.

Bridgeport, Conn.

We are advised by Dr. William Paul Gerhard that in the Annual Report of the Library Board, published in the February 1919 issue of MECHANICAL ENGINEERING, p. 183, an error has been made in stating that the collection of books on gas engineering was presented by him to the American Gas Institute. Dr. Gerhard states that these books were originally donated by him to the Illuminating Engineering Society, and transferred to the Library by that society, with his approval.

ENGINEERING SURVEY

A Review of Progress and Attainment in Mechanical Engineering and Related Fields, as Gathered from Current Technical Periodicals and Other Sources

SUBJECTS OF THIS MONTH'S ABSTRACTS

AERONAUTICS

The Aeroplane in Curvilinear Flight (*Schwerz, Aero. Club Bulletin*, Nos. 8 and 9). The article describes an investigation into the attitude taken up by an aeroplane in curvilinear flight. It is admittedly only a very approximate method, assumptions being made in order to simplify the mathematics. When an aeroplane turns, it banks, and if the banking is excessive the machine sideslips inward, the opposite being the case if the angle bank β is not large enough. First of all the author examines the relation between β and other quantities, defining the machine and the motion.

If ρ be the radius of curvature of the path and V the velocity, then the angle of bank β is given by $\tan \beta = V^2/\rho g$, assuming the sine law for the resistance of the planes.

A few remarks are made on the gyroscopic effect of the airscrew either in assisting or opposing the banking movement, together with a consideration of the difference in the lifts on the two wings due to the circular motion.

The effect of the angle of the rudder is next examined, and an expression is derived for the radius of curvature of the path. If F_s be the area of the rudder, and a the initial value $(t = 0)$ of the angle through which the rudder is turned, then the component forces acting on the rudder parallel and perpendicular to the longitudinal axis of the machine are respectively—

$$R_s = r^2 F_s \sin^2 a \psi \gamma / g$$
$$A_s = r^2 F_s \sin a \cos a \psi \gamma / g$$

γ = the density of the air and ψ is a constant coefficient. The latter force produces a moment about the vertical axis through the center of gravity and if the average be l, M can be written in the form

$$M = C \sin 2a$$

C being assumed constant and equal to $\psi \gamma l r^2 F_s / 2g$, and the moment produced by R_s neglected in comparison with M. Further neglecting the opposing moments due to difference of the relative speeds of the outer and inner wings, the equation

$$\frac{d^2\phi}{dt^2} = \frac{C \sin 2a}{J}$$

is obtained, where ϕ is the angle between the original rectilinear flight path and the axis of the machine at time t, and J the moment of inertia about the vertical axis through the center of gravity.

On the integration this gives the angular velocity

$$w = \frac{C \sin 2a}{J} t$$

and the angular displacement $\phi = \dfrac{C \sin 2at^2}{2J}$ and since $\phi = rt/\rho$,

$$\rho = 2rJ/C \sin 2at$$

In actual flying the banking of the machine due to difference in the speed of inner and outer wings will cause the machine to "take the curve" and the centrifugal force will balance the lateral force so as to do away with sideslipping.

It is admitted that the above formula for ρ is only a rough approximation, assuming as it does the constancy of a and r. At large values of β, M is usually small; for the extreme case $\beta = 90$ deg., it vanishes. J also ceases to be a principal moment of inertia for values of β other than 0 deg. or 90 deg. Still it is claimed that the approximation is good for the values of β up to about 25 deg. Further,

$$\tan \beta = \frac{r^3 F_s t \sin 2a}{4gJ}$$

Finally a few calculated values of β are given for $a = 5$ deg. and 10 deg. and for values of t varying between $t = 1$ and 20 sec., and the personal element introduced into the control of the machine is discussed. (*Technical Supplement to the Review of the Foreign Press*, London, vol. 3, no. 1, Jan. 7, 1919, no. 3838, p. 22)

Douglas Automatic Aeroplane Ignition Interrupter. The Douglas interrupter was primarily developed for military planes but it may find application also in peaceful aeronautics.

In the event of the propeller's breaking there results a seriously unbalanced condition of the plane. In a tractor plane the tendency is to go into a dive and in a pusher plane to go into a tail stall, and either type of machine is apt to pass into a spin as a result of the unbroken propeller blade tending to swing the machine around a neutral point between the center of pressure of the unbroken blade and the center of torque.

In addition to this the unbalance of the power plant itself due to the unequal torque is apt to break a gasoline line and cause fire.

The operator cannot always be relied upon to cut off the power quickly enough, since the time interval per revolution for aeroplane engines at full throttle varies from 1/23 to 1/27 of a second and conditions may get beyond repair long before the aviator realizes what is wrong with the plane.

The interrupter acts automatically and through practically instantaneous action cuts off the power, thereby confining the danger to the initial breakage, which is seldom serious in itself, provided it is not followed by unbalanced power development. Such an interrupter is probably particularly valuable in the case of twin-engined planes, as such an accident happening to one engine would cause the good engine to suddenly swing the machine around and probably into a spin.

It may be added that, from this point of view, the interrupter practically plays the part of the self-locking differential as preventing the skid of an automobile on a slippery pavement, though acting in an entirely different manner mechanically.

The instrument is very simple and may be briefly described as consisting of a suitably pivoted metal bar so mounted as to swing in a plane transverse to the axis of rotation of the propeller.

Under normal operating conditions the free movement of this bar is confined to a very limited are in its plane of movement by means of tension springs. The amplitude of this movement is determined by the weight of the bar, the intensity and frequency of the transverse vibrations of the engine and the opposing strength of the springs confining it. An intense oscillating shock trans-

verse to the engine such as an unbalanced engine propeller torque reaction resulting from the breaking of a propeller at speed or similar causes will force the bar to swing through its full amplitude, raise a trigger usually held by a compression spring and in this way interrupt the ignition through grounding the magnetos.

On the other hand, there is a compression spring—in itself presenting an unbalanced force—which is designed to prevent the bar from disengaging the ignition latch as a result of cylinder misses coinciding with bad vibration periods of the engine, lateral shocks to which the plane may be subjected at landing, etc. In this way the interrupter automatically differentiates between harmless vibrations and intense oscillating shocks transverse to the axis of the engine which may cause a dangerous state of dynamic unbalance.

It was feared at first that the presence of this instrument would be apt to complicate ignition, particularly so on the Liberty engine where the double distributor system is used. Actually, however, it has been found that no trouble results from its installation.

Two types of interrupters have been developed: one of the Mecca type for magneto ignition, and the other of the breaker type for battery-generator engines, such as the Liberty. (*Aerial Age Weekly*, vol. 8, no. 23, February 17, 1919, pp. 1121 and 1141, 4 figs., *d*)

Italian Aircraft Engine as Redesigned in U. S. A.

THE KING-BUGATTI AVIATION MOTOR, G. Douglas Wardrop, Mem.Am.Soc.M.E. An interesting feature of this motor is that it represents practically a foursome assembly. There are four carburetors, each supplying one block of four cylinders and likewise four magnetos, two on each side of the engine (Fig. 3).

The carburetors are specially designed Miller, feeding through separate water-jacketed manifolds. They are set low so that gravity feed may be used and all four are identical, there being no rights or lefts.

Fig. 1 shows the carburetor assembly, which apparently does not very materially differ from the ordinary Miller carburetor.

The throttle valve is of the barrel type; the axes of all valves being parallel with the center line of the engine, the two carburetors on each side of the engine being operated by one shaft which is connected with the valves at each end through adjustable couplings. The shafts on the two sides of the engine are connected so that all four valves move in unison, the valve openings being synchronized by means of adjustable couplings.

From the float chamber which is controlled in the usual manner the gasoline enters the jet holder in which there are seven jets with drill sizes from No. 76 for idling to Nos. 76, 75, 71, 68, 57 and 53. These jets progressively come into action as the throttle is opened, thus gradually giving an increasing supply of gasoline.

Gasoline is drawn into the jet through the small hole in the bottom of the threaded end, mixing with a certain amount of air sucked in through the four holes drilled in the barrel of the jet just above the threaded portion. This air is taken from the outside through the upper 3/16-in. hole in jet holder and passes down around the outside of the jet to the four holes mentioned above. The major portion of the air enters the carburetor through the lower end of the venturi, which is 3 in. in diameter, passes up around the jet bar holder, combining above this with the rich mixture from the jets to form the proper mixture for combustion.

Assembly of the altitude valve is shown on drawing (Fig. 2). This valve operates by turning the lever which is attached to the altitude-control valve. This valve has two openings in its seat which when in the open position register with two similar openings in the stationary cover, thus making two free passages to the outer air, the size of these passages being governed by the position of the lever.

There are four outlets (Fig. 2), one of which connects to each of the four elbows, opening directly into the top of the float chamber. The float chamber is always in direct connection with the venturi through a 5/64-in. drilled hole opening into the venturi about ¼-in. above the jet holder and into the float chamber well above the gasoline level. Opening the altitude-control valve decreases the vacuum thus increasing the flow of gasoline through the jets.

Oiling is by pressure feed and spray. There is one pressure and one scavenging pump, both of the rotary-gear type. These are located at the front of the engine, driven directly from the crankshaft through a pin and slotted coupling, Figs. 4 and 5. This coupling is squared to the pump shaft but is not pinned, thus relieving the shaft of any end driving pressure. The gears in both pumps are the same except that the scavenging pump gears have a wider face. The oil is forced into the pressure line running the entire length of the crankcase. An adjustable pressure-regulating valve is located in the crankcase front-gear cover, generally set so that the pressure gage which is connected to the rear end of the main oil line in the crankcase registers about 30 lb.

This valve has holes drilled through the head so that there is always a certain amount of oil discharged on to the gears.

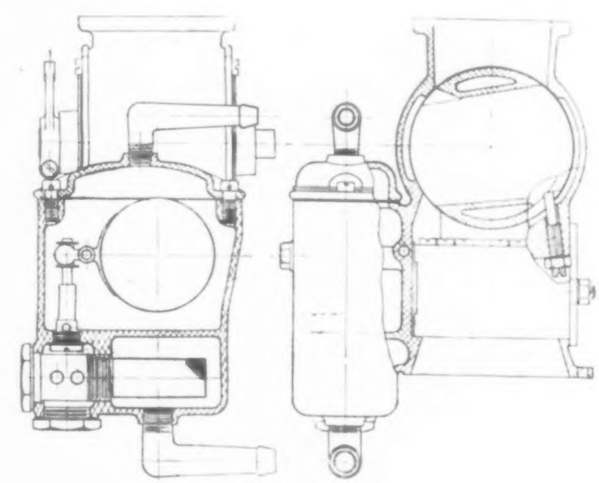

FIG. 1 CARBURETOR ASSEMBLY

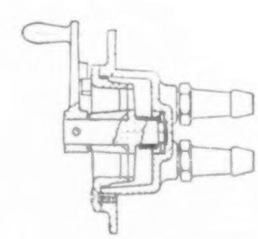

FIG. 2 ALTITUDE-CONTROL-VALVE ASSEMBLY

Cooling water is circulated through the engine by means of a centrifugal pump, see Fig. 6, driven from the rear end of the left-hand crankshaft by a pin and coupling the same as used on the oil pump.

The cooling system from the pump inlet to the outlet elbows on the front cylinders holds 4¼ gal. of water.

The pump impeller is 5⅛ in. in diameter with eight vanes, the web being drilled with eight ⅜-in. holes on a circle of 2 in. diameter to equalize the water pressure.

The pump shaft is packed with a graphite-asbestos rope packing, automatically held together under compression by a coiled spring acting on the gland.

The pump shaft is hollow, the rear end being in direct communication with the water in the pump case. Water entering the shaft is pumped out to the shaft rear-bearing surface through a ⅛-in. hole. Any leakage of water past the asbestos packing is drained outside of the crankcase through a ⅝-in. cored hole in the water-pump body. The front bearing on the pump shaft is lubricating by spray from the crankcase which collects on the shaft-bushing support and drains down into a ⅛-in. hole leading

to the bearing. Any oil leakage from the front end of this bearing returns to the pump, and slight leakage from the rear end of the bearing is drained outside of the crankcase with the water leakage from the rear bearing.

There is one water inlet to the pump $2\frac{1}{4}$ in. in inside diameter while the single outlet is $2\frac{3}{16}$ in. in diameter. Water from the pump is forced up into an aluminum pipe with one branch leading to the rear end of each of the rear cylinder blocks, water entering the cylinders at the top of the water jacket on the exhaust side. A certain amount of the water circulates through the inlet manifold jacket, the remaining filling the cylinder water-jacket space.

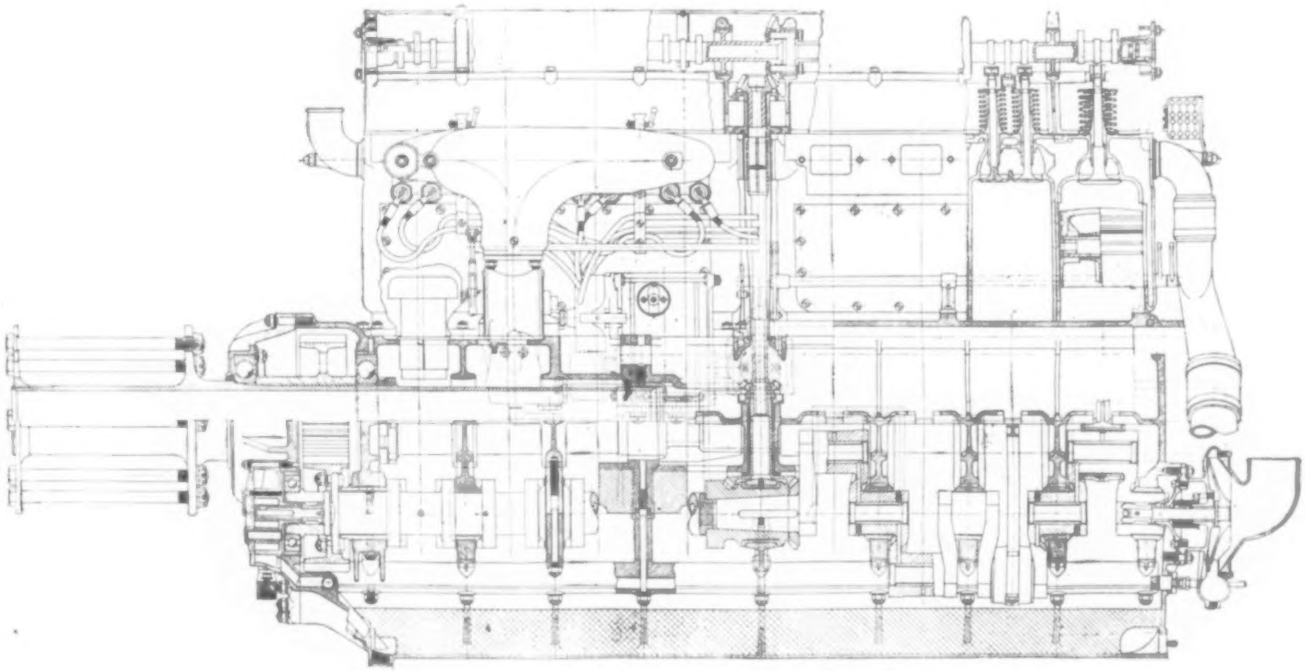

Fig. 3 The 410-h.p. King-Bugatti Engine, Longitudinal Section

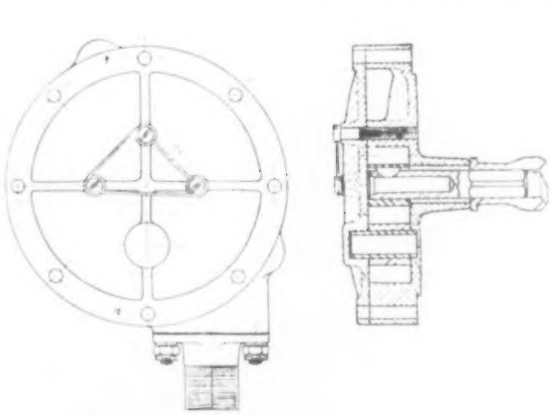

Fig. 4 Oil-Pressure-Pump Assembly

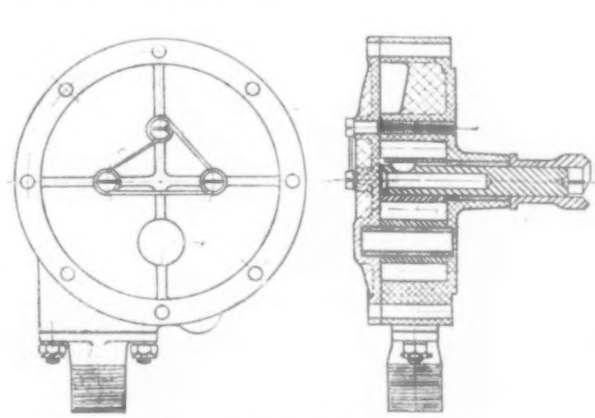

Fig. 5 Oil-Suction-Pump Assembly

Cylinder blocks are cast with integral water jackets, except the sides below the inlet and exhaust ports, which are covered by an aluminum water-jacket plate held in position by screws.

The construction of the water passages in the head of the cylinder is such that the valve stems and exhaust passages are very thoroughly cooled.

All four cylinder blocks are identical, the water passing from the rear to the front cylinder blocks through openings similar to the inlet opening, leaving the front blocks through another similar opening.

The crankshaft is made in two pieces connected at the center by a taper and key drawn up with a nut. Each section of the shaft forms a four-cylinder shaft with the throws all in one plane, the throws of the two sections being assembled at right angles. In assembling the rear end of the front half is immersed in boiling water the tapering end of the rear section which is cold is then slipped into position and the parts drawn together by the nut, using a long-handled wrench. The rear end of each complete shaft has clutch teeth cut on it for attaching the starter. All bearings including the connecting-rod bearings, with the exception of the center main bearings, are undercut. This results in a total shortening of the shaft of approximately 4 31/32 in. This results in a considerable saving in the weight of various parts, while still allowing ample bearing surface. The crankshaft main bearings are bronze bushings babbitt-lined. They are not relieved at the parting line and in the majority of them there are no oil grooves at all.

Contrary to the system used in the Liberty engine, the cylinders are of iron cast in blocks of four. The water jacket is cast integral, with the exception of the sides of the cylinder block below the inlet and exhaust ports, which are covered with the cast aluminum plate attached with screws. The cylinders are bolted directly to the top of the crankcase without the use of a gasket, but a gasket is used between the water-jacket aluminum plates and the cylinder. Provision is made for a liberal circulation of water in the neighborhood of the valve ports, seats and guides. The spark plugs, of which there are two per cylinder, are located at the side of the combustion chamber in close proximity to the

inlet valves and are well cooled by the circulating water. (*Aerial Age Weekly*, vol. 8, no. 22 and 23, Feb. 10 and 17, 1919, 51 figs., *dA*)

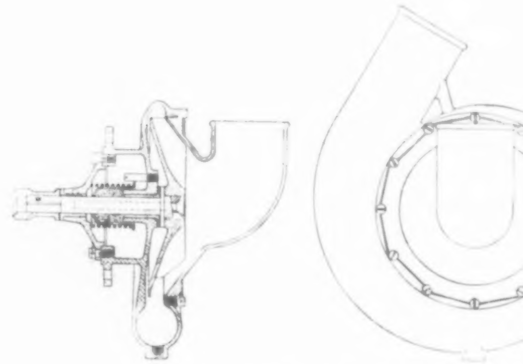

Fig. 6 Water-Pump Assembly

CEMENT AND CONCRETE

Influence of Vibration Upon Concrete (*Deutsche Bauzeitung*, Sept. 28, 1918). In concrete construction it is generally believed that vibration during the period of setting has a bad effect, so that it must be prevented as much as possible. On the other hand, tests made by von Bach in 1905 on the frictional resistance of iron reinforcement in concrete showed that this was increased by vibration during setting and varied inversely with the quantity of water present in the concrete mass.

The German Committee for Reinforced Concrete decided to make further tests to verify von Bach's results, and the figures are set forth in a pamphlet of 88 pages, with 33 tables and numerous photographs of fractured test beams. The vibration or shaking is divided into three classes, which are described in detail. The test beams of a transverse section 20 cm. by 30 cm. were laid across supports 2 m. apart. They were made of concrete composed of 1 part cement to 4 parts of gravelly sand, or 1 part cement, 2 of sand, and 2 of syenite broken fine and reinforced with iron rods of 16 mm. section. Both kinds of concrete were used in three degrees of dampness. Fluid concrete is more sensitive to vibration than concrete with less water. The precise figures for surface friction in the iron are not given. (*Technical Supplement to the Review of the Foreign Press*, London, vol. 2, no. 13, Dec. 24, 1918, no. 3619, p. 364)

GAS PRODUCERS (See Mechanical Processes)

HYDRAULIC MACHINERY

A New Type of Water-Turbine Governor

Water Turbine at the Hydroelectric Plant at Kubel, Switzerland. Description of a new turbine and governor installed at a Swiss hydroelectric plant by the Escher-Wyss Company.

This turbine was installed in 1915 and is rated at 2500 hp. at a speed of 500 r.p.m. The turbine presents several interesting innovations both on the hydraulic and the electric end. Thus, the alternator bed has to support only the weight of the shaft end and the rotor, but does not have to take care of any load coming from the turbine itself, as the axial thrust is hydraulically balanced by means of a special device. This balancing is produced by the pressure of the water circulating in two annular passages located on each side of the runner. To make this possible, the runner has its two faces carefully ground and so arranged that there is an interval of a few tenths of a millimeter between the runner faces and the corresponding surfaces of the side bracket on one side, and the discharge pipe on the other side. If the runner should shift from its central position the pressure, because of the change in volume of the interval, will rise in one of these annular passages, while it will fall off in the other, and this will tend to bring the runner back into its central position.

The most interesting feature in the installation is the new type of Escher-Wyss governor. Its general construction is shown diagrammatically in Fig. 8, and its essential characteristic lies in the fact that the interruption in the governing movement is as a rule produced just at about the same time when it is necessary.

The double servomotor (2-3) is located in the casing (1), which also serves as an oil reservoir. The movements of the double piston are transmitted by a special articulated lever (4) to the governor shaft (5), which, in its turn, operates the governing organs of the turbine. The distribution of pressure on both sides of the servomotor is effected by means of the valve (7-7*a*) also located in the casing, while the gear pump thus forces by the passage (30) oil under pressure to the centrally located chamber (31) of the governor valve. The same chamber (31) has connected to it the safety valve (8) loaded by means of a spring which regulates the maximum pressure of the oil in the governor. The chambers (32 and 32*a*) respectively located above and below the governor valve provide a means of escape to the oil and are directly connected to the reservoir (1), while the central chambers (33 and 34) are connected by passages (33*a* and 34*a*) to the respective cylinders (3 and 2) of the servomotor, in addition to which these two sides of the servomotor can be placed into communication by means of a valve (9). The edges of the governor valve as well as the distribution valve (7 and 7*a*) have only a very small amount of play when the governing mechanism is in its neutral position and the pump works then at only very low pressure, but this pressure automatically rises when governing becomes necessary so as to overcome the resistance of the servomotor.

The stem of the distribution valve has two collars (12*a*) the purpose of which is to limit its movements, and the distribution valve itself acts through two double levers (11 and 11*a*) between which is located the dashpot (18). This action does not occur directly by means of the centrifugal pendulum (13), but is effected through a device called pre-command, the construction of which has been described on other occasions. This pre-command device is embodied into the upper part of the centrifugal pendulum and, among other things, comprises a differential piston (35). The spring pendulum operates solely the spindle (14), which, turning with the pendulum, makes an integral part therein and influences the distribution of pressure in the differential piston.

A special arrangement is described for very large governors. The operation of the governor during the process of speed regulation is as follows: As soon as the speed of the turbine and that of the spring pendulum (13) rises above the normal value the spindle (14) is raised and the opening in the diaphragm (37) closes so that the whole pressure is applied under the piston (35).

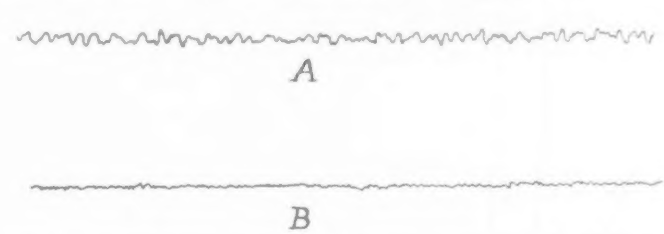

Fig. 7 Tachograms with the Older Type of Escher-Wyss Governor (A) and the New Governor (B) of the Same Company

This piston follows the movement of spindle (14) and raises the operating lever (11), which then instantaneously turns around point (19).

The casing of dashpot (18) is then carried away by the larger spring inside of it and the operating piston (7) is also raised by the casing (18). Since the entire travel of the piston is very slight, a short movement of the spindle (14), that is, a very small change in the number of revolutions, is sufficient to displace over its entire path the piston of the distributing valve and thus communicate the greatest possible speed to the servomotor.

When the piston (7) is in its upper position, this on one hand produces communication between cylinder (2) of the servomotor and the oil pump, and on the other hand opens the connection between cylinder (3) and the outlet passages, which results in a

movement from left to right and produces the closing of the double piston of the servomotor. During this process of governing the number of revolutions of the turbine per unit of time will rise until the servomotor has attained a position corresponding to the new load. During this time the piston (7) preserves its highest position and the cylinder of the dashpot cannot, of course, move any further. Nevertheless, under the influence of the continuing increase in speed the spindle (14) continues to rise together with the pre-command piston (35) and lever (11). As a result the piston enclosed in the dashpot (18) is displaced upward and compresses the upper spring still more. But as soon as the speed of the spring pendulum decreases to such an extent that the spindle (14) and hence the pre-command piston (35) begin to fall down, the cylinder dashpot (18) instantly joins its piston because of the oil contained therein. This new position is shown in Fig. 8 at the top and to the right. Because of this the piston of the distributor valve (7) is instantly brought to its middle position and the movement of closing is interrupted, which always happens immediately after the peak of the speed curve is exceeded or at the moment when the position of the servomotor corresponds to the new load. Then, under the influence of the larger spring on the dashpot, the casing of this latter is gradually brought to its middle position and the proper velocity corresponding to the new load is established.

On the other hand, if the speed of the turbine falls below its normal value because of the overload, the same operations take place in an inverse order. In both cases the auxiliary mechanism (16) operates in the usual manner and may be adjusted for either positive or negative effect and for isochronous regulation. The most usual system in the case of turbines driving three-phase generators is to give the auxiliary mechanism a slightly positive action corresponding to only a part of the pendulum motion, while the other part of this motion is likewise used but for varying the speed.

In order to increase the sensitiveness of the apparatus, the pendulum used runs at a very high speed and its inertia masses are reduced to the strictest minimum. Further, the hydraulic pilot piston (35) is located in the immediate vicinity of the pendulum which leads to complete suppression of disturbing oscillations. It is claimed as a further advantage of the new governor that all of its rotating parts are located inside of a casing which prevents projection of oil outside; also, the oil reservoir is completely enclosed and is thereby protected from access of impurities.

Acceptance tests were carried out in October 1916 and are claimed to have given excellent results. Of particular interest are tachograms taken; the first (A) on six turbines equipped with the old-style governors, and the second (B) on six other machines equipped with the new governor. A glance at the two curves indicates the great improvement made by the use of the new apparatus (Fig. 7). (La nouvelle turbine de 2500 ch de l'usine hydro-electrique de Kubel près Saint-Gall (Suisse), P. V. *Revue Générale de l'Electricité*, vol. 5, no. 1, Jan. 4, 1919, pp. 19-25, 9 figs., *dA*)

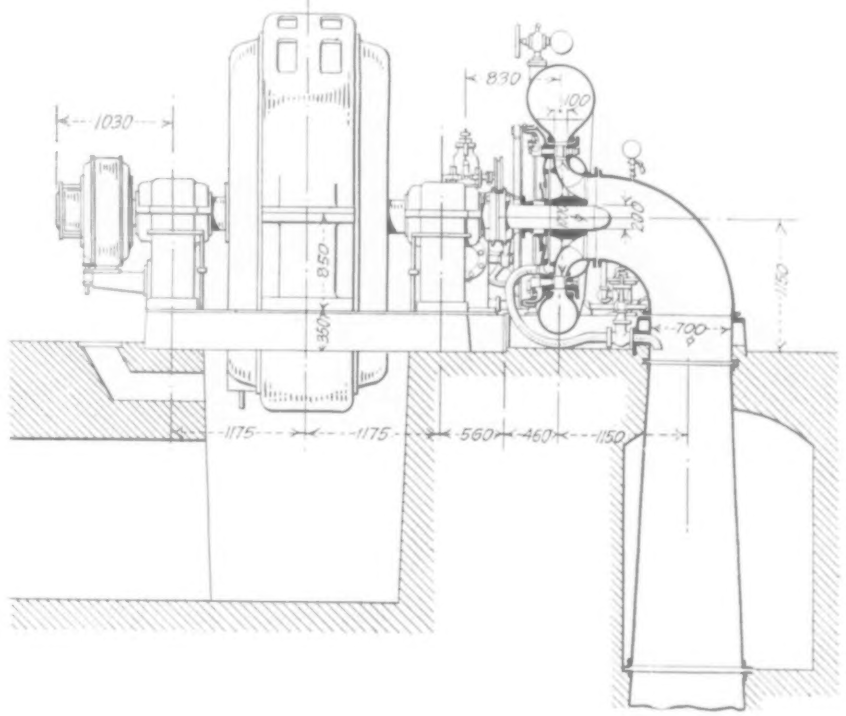

Fig. 9 Axial Section of the Swiss Hydraulic Turbine at Kubel

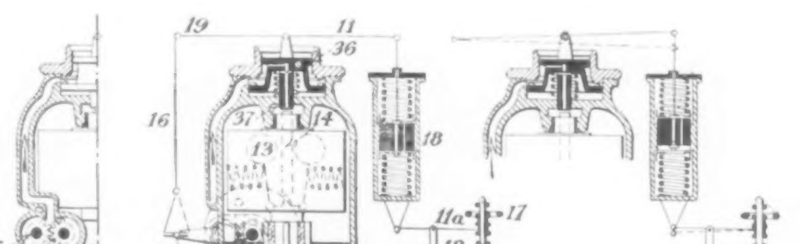

Fig. 8 Section and Details of the New Governor on the Kubel Hydraulic Turbine

INTERNAL-COMBUSTION ENGINEERING (See also Aeronautics)

The High-Compression Oil Engine, W. G. Gernandt. Comparative discussion of high-compression oil engines of various cycles, covering the four-stroke constant-volume or Otto engine, the Diesel or high-compression engine, the Hvid engine, the McClintock and the Gernandt engines. The writer gives in each case a brief summary of what he considers the advantages and disadvantages of each cycle.

In the Gernandt engine the fuel is injected into the combustion chamber by supercompressing a portion of the products of combustion which have been trapped at the time the pressure in the cylinder has attained its maximum. Mechanically this can be accomplished in various ways, depending on the general design of the engine, and the trapping chamber may be actually sealed by the use of valves between the supercompressing means and the combustion chamber, or be in direct communication with the combustion chamber through very small injector holes.

The injection itself takes place as follows: Taking the case of a four-cycle engine the fuel is deposited during the suction stroke in a small chamber between the combustion chamber and the supercompressing means. This fuel is metered and passed through a mechanically timed valve. During the compression stroke the fuel attains the necessary temperature and the pressure rises in the fuel chamber. When the piston reaches its upper dead center the products of combustion previously trapped are supercompressed mechanically and forced through the fuel chamber and into the combustion chamber. (This sentence is repeated verbatim from the original article. From it, it would appear that combustion takes place previous to supercompression.)

It is claimed that, contrary to what occurs in the Diesel engine, the injection gas is highly heated and refrigeration has been practically eliminated, the amount of fuel necessary for injection being so small that the burning effect has not been impaired. Also there is no burning of the fuel until it is actually injected into the combustion chamber.

It is claimed that actual tests on this method of injection have shown promising results. No data of tests are, however, reported in the original article, except in answer to some questions during discussions. From these it appears that the engine which gave promising results is a 4-in. by 6-in. single-cylinder stationary engine in which the speed ranges from 200 to 860 r.p.m. No data as to horsepower developed are given. The compression is about 450 to 500 lb., depending upon the fuel used. The control of the engine is entirely by the amount of fuel burned. The needle valve regulates the quantity of fuel. Runs have been made at speeds as low as 200 r.p.m.

No data are given as to the amount of power developed at the various speeds. (*Journal of the Society of Automotive Engineers*, vol. 4, no. 2, February 1919, pp. 112-118, 3 figs., *cd*)

MACHINE DESIGN

INVENTION IN SMALL MECHANISM (*Technique Moderne*, October 1918). The small mechanism to which the present article alludes is that of a size most commonly used in watchmaking, etc.

It is not sufficient to have a knowledge of kinematics and forms of mechanisms to be able to design machines. It is necessary, first, to be familiar with the characteristics of small mechanism, then to know how to state a practical problem for solution, so as to be able to unite the experimental data which are concerned and to think out tests on apparatus which are the embryos of the machines to be built.

The choice and the design of cams play the principal share in this second part of the realization of an industrial invention; they are governed by simple rules that are ignored by too many inventors, whereas if these rules are followed the efficiency of the machine can often be increased.

The author treats the subject in considerable detail over eight pages of the journal. The first portion deals with the general problem; this is followed by a section dealing with the classification of types of cams and study of motions caused by cams and rollers. Section 3 discusses the stages of a mechanical invention, and, finally, the author illustrates his idea by describing a complicated machine for making the paper tubes for cigarettes. The object is to show that there are rules and methods of procedure which should be followed in the process of mechanical invention, and that if they are carefully followed far better results will be attained than if mere rule-of-thumb methods and random experiments are made. The author, Mr. Emile Belot, has successfully designed a large number of machines for industrial purposes. (*Technical Supplement to the Review of the Foreign Press*, London, vol. 3, no. 1, Jan. 7, 1919, no. 3750, p. 8)

MACHINE SHOP

BOILING TANKS IN LOCOMOTIVE WORKSHOPS (*Organ für die Fortschritte des Eisenbahnwesens*, Oct. 1, 1918). In the locomotive repair shops at Karlsruhe steam-heated boiling tanks have been installed, in which the parts of locomotives and vehicles are cleaned before they are repaired. The tanks are large enough to receive the bogie frames, and the installation comprises the boiling tank containing the washing fluid; the rinsing tank, in which the boiled articles are treated with cold water; a tank in which the washing fluid is cleaned for use again; and an overhead crane. In one installation the washing fluid is heated by the admission of steam through nozzles, and in the other it is heated by steam coils. The advantages and disadvantages of the two systems are discussed in the article. The working drawings to scale are reproduced in plates, which are bound up with the journal.

The washing fluid consists of 100 grams of 80 per cent caustic soda to 1 liter of water, the whole kept at a temperature of 80 deg. to 90 deg. cent. The use of steam boiling nozzles is not recommended, as the solution is gradually weakened; heating by steam pipes is much better, but the water must be kept stirred. The fluid is pumped out of the boiling tank and lifted to the storage tank at high level by a centrifugal pump, the suction pipes inside the boiling tank having nozzles pointing upward. The stirring of the boiling liquid is now effected by means of a jet of air under pressure. Complete bogie frames can be thoroughly cleaned in 50 to 70 min., and the air jet is only required for the last 15 min. The cost of steam is the most important factor. The boiling tank is 7 m. long by 3.213 m. wide by 1.500 m. deep, and the author gives calculations for the consumption required. Most of the dirt falls to the bottom of the boiling tank, and the proposed filtering apparatus in the high-level tank is not yet perfected. With the large new apparatus it is found that a saving in cost of cleaning of 40 per cent is effected, as against the former system, in which small tanks and steam nozzles were employed, and the cleansing is far more thoroughly done. (*Technical Supplement to the Review of the Foreign Press*, London, vol. 3, no. 2, Jan. 21, 1919, no. 3839, p. 39)

THE EFFECT OF TEMPERING ON WATER-QUENCHED GAGES. The following information has been supplied by Automatic and Electric Furnaces, Ltd., 6, Old Queenstreet, London, S. W.:

Two gages of ¾ in. diameter, 12 threads per inch, were heated in a Wild-Barfield furnace, using the pyroscopic detector, and were quenched in cold water. They were subsequently tempered in a salt bath at various increasing temperatures, the effective diameter of each thread and the scleroscope hardness being measured at each stage. The figures are in 10,000ths of an inch, and indicate the change + or — with reference to the original effective diameter of the gages. The results for the two gages have been averaged (Table 1).

TABLE 1

Thread	After quenching	Tempering Temperature, Deg. Cent.					
		220	260	300	340	380	420
1	+25	+19	+17	+15	+15	+11	+11
2	+18	+12	+11	+ 9	+ 6	+ 5	+ 5
3	+12	+ 6	+ 5	+ 3	0	0	0
4	+10	+ 4	+ 4	+ 2		0	— 1
5	+ 9	+ 4	+ 4	+ 2	0	0	0
6	+ 9	+ 4	+ 3	+ 2	0	0	0
7	+10	+ 5	+ 5	+ 3	+ 2	+ 1	+ 2
8	+ 8	+ 4	+ 3	+ 2	0	0	+ 1
9	+ 9	+ 4	+ 3	+ 2	+ 1	+ 1	+ 1
10	+ 9	+ 5	+ 5	+ 3	+ 2	+ 2	+ 2
11	+ 7	+ 4	+ 4	+ 2	+ 1	+ 1	+ 1
12	+ 9	+ 5	+ 5	+ 5	+ 4	+ 4	+ 3
Scleroscope	80	70	70	62	56	53	52

Had these gages been formed with a plain cylindrical end projecting in front of the screw, the first two threads would have been

prevented from increasing more than the rest. The gages would then have been fairly easily corrected by lapping after tempering at 220 deg. cent. Practically no lapping would be required if they were tempered at 340 deg. cent. There seems to be no advantage in going to a higher temperature than this. The same degree of hardness could have been obtained with considerably less distortion by quenching directly in fused salt. It is interesting to note that when the swelling after water quenching does not exceed 0.0012 in., practically the whole of it may be recovered by tempering at a sufficiently high temperature, but when the swelling exceeds this amount the steel assumes a permanently strained condition, and at the most only 0.0014 in. can be recovered by tempering. (*The Engineer*, vol. 126, no. 3286, December 20, 1918, p. 537, *ep*)

MACHINE TOOLS

Precision Lathe for Cutting Screw-Thread Gages

A British Precision Screw-Cutting Lathe. Description of a machine tool made by Alfred Herbert, Ltd., of Coventry, England, designed for the single purpose of cutting the thread on a screw gage. It is capable of cutting a screw up to 3 in. long on a cylinder up to 6 in. long and up to $2\frac{1}{2}$ in. in diameter.

Although the machine is intended solely for cutting screw threads, it is a true lathe and not a screw machine. The work revolves on centers and the cutter is a single-point tool clamped to a slide rest. The cutting movement on the tool is controlled by a lead screw and both the turning and the traveling movements are positively related by toothed gearing controlled by a single belt drive.

The main difficulties in cutting accurate screw threads on an ordinary lathe arise from—(1) Imperfect alignment between the axis of the work and the line of travel of the tool, a condition which may be due to distortion of the bed, warm centers, looseness of the spindle, etc.; (2) irregular or unsteady travel of the saddle; (3) want of means for making small corrections in pitch; (4) errors in adjusting the tool in the slide rest to the correct height and angle, and (5) the faulty clearing of the tool at the end of the cut and advancing it with the precise addition for the new cut.

These and other difficulties can all be overcome on an engine lathe by an experienced man of careful method, provided he be allowed a large proportion of non-cutting time. But even with the best of the engine lathes and the best of men screw cutting demands very close and sustained attention. The new lathe has been designed to facilitate thread cutting on screw gages and similar high-precision work.

A general view of the lathe is given in Fig. 10. The stands of the bed are inverted cast-iron boxes with walls of uniform thickness. The arrangement of the feet is shown in section at A in Fig. 12. The foot is a bolt with a ball-head extension which rests in a cup within a socket. One foot is secured against horizontal movement by making the cup a close fit in the socket, while the others have a little play to accommodate the movement caused by the expansion of the bed under a change of temperature. All three feet are held down to the stand securely but not harshly. The makers hold that distortion of lathe beds is mainly due to tying the bed down at four or more points and so producing on one hand a permanent stress by reason of inequality of pressure at these points and varying stresses by reason of the lack of freedom for expansion.

In the headstock both centers are stationary or dead. The work piece is fixed in with a carrier and is driven by a box pin. It should be borne in mind that only the screw cutting is done on this lathe, the piece being previously finished to thread-crest diameter. The driving plate A, Fig. 11, revolves on a bearing surrounding the fixed headstock center, and has spur teeth cut on its rim. The driving spindle is driven by a three-step pulley, and has a pinion B at one end gearing with the driving plate and a pinion C at the other end gearing with the change wheels. When a gear train is set the plates carrying it are rigidly bolted to the frame, so that the wheels work steadily together. The wheels A and B, Fig. 11, reduce the driving-plate speed to one-fourth of the belt-pulley speed; therefore the pinion C makes four revolutions to one revolution of the work piece. The lead screw is cut with eight threads to the inch.

The lead screw is short (it does not reach to the back of the driving belt) and lies well above the lathe bed and between the V-guides of the saddle. This position gives a more direct pull than does the usual under saddle frontal arrangement.

The lead-screw nut is carried on a bracket rising from an extension of the saddle. It is not a split nut, the arrangement

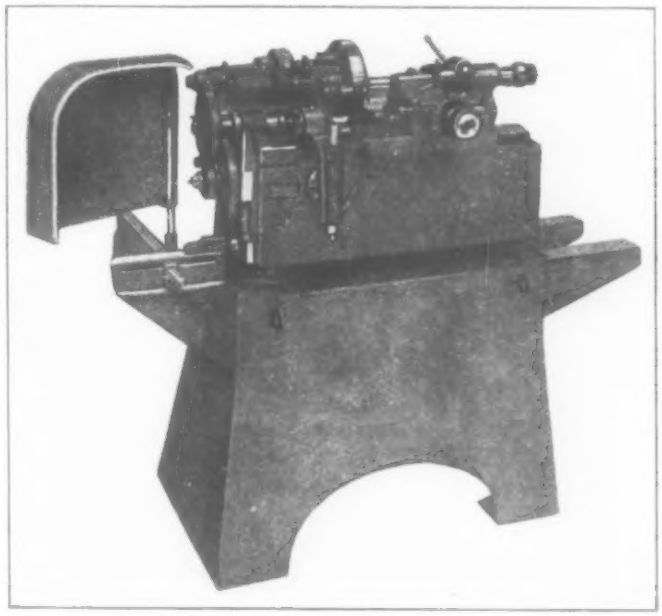

Fig. 10 General View of Precision Screw-Cutting Lathe

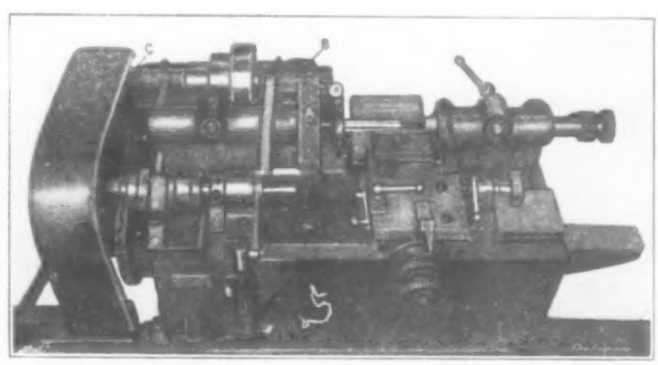

Fig. 11 Plan View of Precision Screw-Cutting Lathe

being that the reverse motion is obtained from the countershaft which is fitted with a two-speed reversing gear.

If the thread is cut correctly to pitch in the soft steel the pitch will be short when the steel is hardened. It is therefore necessary that a screw of, say, sixteen threads to 1.000 in. should be cut as sixteen threads to, say, 1.001 in., but this margin will vary with different steels and perhaps with different diameters. An extremely delicate means of varying the pitch is therefore necessary, and it must act evenly on every thread. This variation is obtained by the gear shown at the front of the lathe in Fig. 13. The vertical sliding rod carries a peg passing through its lower end and projecting into the slot plate attached to the bed of the lathe. The upper end of the sliding rod is attached to a lever arm controlling the lead-screw nut. The casing in which the rod slides is rigidly attached to the saddle and moves with the saddle in its travel. If the slot is set parallel with the lead screw the nut will be held stationary and the pitch of the thread will be cut true to the change-wheel setting. If the slot is set at an angle to the lead screw the sliding rod will move vertically and partially rotate the nut. The slot plate is graduated round its edge so that it may be

easily set to produce a variation of pitch either above or below the change-wheel setting. The graduations indicate 0.0001 per inch of screw to be cut.

The tool as shown at *B* in Fig. 12 is of special construction. The stock or shank is round in cross-section and is ground parallel to $\frac{3}{4}$ in. diameter, less half a thousandth. The total length is about $3\frac{3}{4}$ in. The grinding and lapping end to any angle, and to the necessary degree of accuracy, is provided for in a way which it is claimed puts this usually difficult operation within the reach

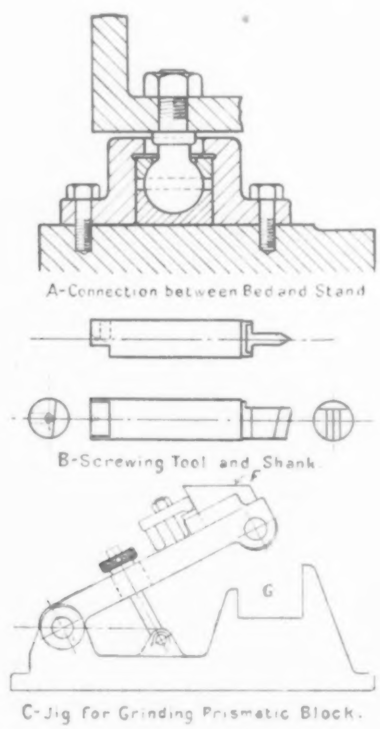

Fig. 12 Details of Precision Lathe

of an unskilled operator on a surface grinding machine. A block for holding the tool by its shank is provided in a jig on a box-like base which may be secured to a grinding-machine table. The holding block rests at an angle on a prismatic block which sets the surface to be dressed parallel with the grinding table. Everything, it is stated, is easily adjusted and secured so that by passing the tool under the grinding wheel the correct angle is obtained. The grinding of the prismatic block is provided for by a jig, as shown at *C*, Fig. 12, in which a sine bar is embodied so that the surface of the block to be ground may be easily and rapidly set to give the correct angle. The calculations of the precise angles of the prismatic block reduce to finding the thickness of a packing piece to be laid under the free end of the sine bar. The various thicknesses have been tabulated for all required tool angles. In Fig. 12 (*C*) the surface of the prismatic block to be ground is indicated at *F* and the space for the packing piece at *G*.

Where gages are being produced in quantity the roughing and finishing cuts for the thread may be taken on successive settings of the lathe or in two or more lathes operating in series. It is claimed that on this lathe unskilled operators are enabled to produce screw threads of the greatest precision that can be measured. One horsepower is required to drive the lathe and the total weight of the machine is a little over 14 hundredweight. (*The Engineer*, vol. 126, no. 3287, December 27, 1918, pp. 558-560, 9 figs., *dA*)

MEASURING INSTRUMENTS

Centrifugal Tachometers, Conical-Pendulum Type

Centrifugal Tachometers on the Principle of the Conical Pendulum (*Zeitschrift des Vereines deutscher Ingenieure*, Nov. 16 and 23, 1918). The article is in two parts and describes five main types of centrifugal tachometers. The general theory of each type is given, and the relation between u, the revolutions per minute, and α, the angular displacement of the arms of the conical pendulum, is worked out. There is for each type a variable β, such that $u = f(\alpha, \beta)$, and a series of characteristic curves of u against α are drawn for a range of values of β.

a Conical pendulum with flat-spiral-spring control. In this instrument the shaft, whose revolutions are to be measured, carries two arms in the form of a cross, each of which can turn about its center, i.e., about an axis at right angles to that of the shaft. Each arm also carries a ball at each end. The couple due to the centrifugal forces on the balls is balanced by that due to the pull in a flat spiral spring whose plane is parallel to the two arms.

The variable parameter β in this case is the angle α_0, which is the value of α when u is zero. The characteristic curves show that positive values of α_0 up to about 30 deg. give the best range of measurable speeds, and the most open space. α_0 is positive when the zero position (spring unstretched) is such that the spring is extended when the arms begin to move outward and away from the axis.

The angular movement of the arms is communicated by means of a pair of links to a sleeve which slides on the revolving shaft. The axial displacements of the sleeve are transmitted by means of a connecting rod and crank to the scale pointer. An excellent

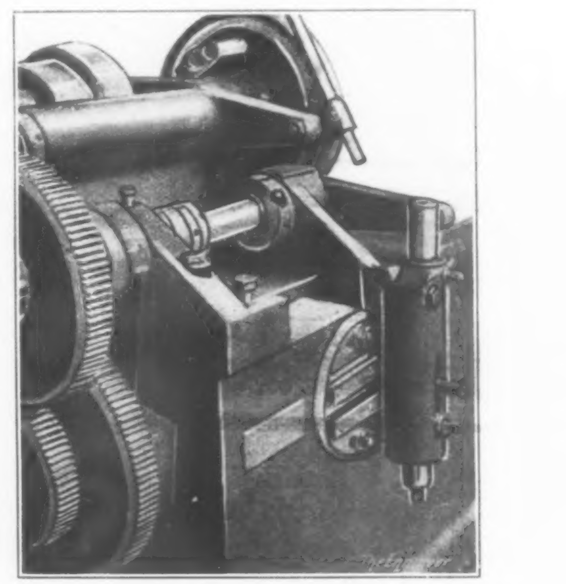

Fig. 13 Lead Screw and Nut of Precision Lathe

uniform scale over a fairly wide range of speeds can be secured in this manner; the best results are obtained if the joint of connecting rod and crank lies above the crank center when the shaft is at rest, assuming the axis of the shaft to be vertical.

b Conical pendulum with gravity load. This is an instrument on the principle of the Watt governor. It can only be used for limited ranges of speed. Characteristic curves are shown in which the variable parameter is the ratio between the distance of the hinges of the arms carrying the balls from the axis of rotation and the length of the arms.

c Conical pendulum with linear-spiral-spring control. This scheme is the basis of successful types of accurate tachograph. The pendulum masses are joined directly by the spring, and their arms are hinged about the ends of a bar which is at right angles to, and turns with, the shaft whose revolutions are to be measured. The angular movements of the pendulum arms are communicated by a link mechanism to a sleeve on the shaft, and the sleeve's movements are directly transmitted to the pen which traces a record on a revolving drum.

The characteristic curves are drawn with the unstretched length of the spring as the variable parameter. They show that the

principle is only applicable to cases where the speeds to be recorded are merely comparatively small variations from a constant mean.

d Centrifugal tachometers with differential gear drive. In these instruments the principle of the foregoing centrifugal tachometers, viz., a conical or rotating pendulum controlled by means of springs, is utilized, but the method of registering the deflection of the arms is essentially different. In outline the method is as follows: The displacement of the rotating pendulum masses produces a relative motion between two concentric shafts, one of which is connected to one side of the differential gear, and the other (a hollow shaft) is driven directly through bevel gearing from the main shaft. This hollow shaft has a speed of rotation equal and opposite to that of a second hollow shaft, also driven from the main shaft by bevel gearing, and connected to the other side of the differential gear. The above-mentioned relative displacement of the concentric shafts can therefore be seen as a displacement of the axis of the two middle wheels of the differential gear with respect to the axis of the shaft, and this latter displacement is registered by the indicator. The arms carrying the rotating pendulum masses have their hinges at opposite ends of the diameter of a rotating disk mounted on the hollow shaft, and the axes of the hinges are also those of a pair of toothed wheels which gear with a pinion on the inner shaft. Any displacement of the arms gives rise to a turning of the toothed wheels, and therefore to a relative movement between the two concentric shafts.

If the centrifugal forces on the rotating masses are balanced by flat spiral springs, then the characteristic curves are similar in character to those of type *a*. There are no improvements in the characteristics as compared with type *b* when the two means of the present kind of tachometer are joined by a linear spiral spring. An instrument can, however, be devised which gives an excellent linear relation between *n* and *z* and over a very wide range of speeds. The essential point of such an instrument is to choose suitably the position of the fixed end of a straight spiral spring which is attached at its other end to one ball only. The axis of the spring should be roughly at right angles to the mean position of the arm carrying the ball.

e Centrifugal tachometers with combined spring and gravity loading. The example given of this type is a combination of types *b* and *c*, and its characteristic curves are certainly an improvement upon those of either *b* or *c*, both as regards range and approximate proportionality between *n* and *z*. (*Technical Supplement to the Review of the Foreign Press*, London, vol. 3, no. 2, Jan. 21, 1919, no. 4015, p. 58)

MECHANICAL PROCESSES

Making Seamless Tubes. Description of the process of manufacture used at the plant of the Standard Seamless Tube Company at Economy, Pa., particularly interesting because of the fact that the plant has only been recently erected and therefore embodies the latest ideas in equipment and methods of manufacture.

The plant is equipped to make boiler tubes for stationary and marine boilers and for locomotives from 1 to 4 in. outside diameter, both hot-rolled and cold-drawn as well as seamless steel tubing for various mechanical processes.

Both basic open-hearth furnace and electric (Héroult) steel are used. Considerable care is used to remove all surface defects from the blooms, air-operated chipping hammers being provided for this purpose, the work going on day and night, with electric illumination during the latter period. Each workman engaged in chipping is required to wear goggles so as to protect his eyes against possible injury.

From the chipping house the bloom goes into a continuous heating furnace and from there it is delivered by a charging machine to a 23-in. bar mill. This mill consists of eight stands of three-high rolls arranged in parallel and driven by a motor through reduction gears. Two electrically driven tilting tables are placed on the front and rear sides of the roll stands. From the bar-mill rolls the bar is transferred by a runout table to the hot saw, which cuts the bar either into merchant sizes or to the size which the piercing mill is working.

This latter is of the Stiefel type and is electrically driven. In the mill the bar is passed through it over a mandrel, as shown in Fig. 14. After a hole has been pierced through the center of the bar the resultant tube is passed successively through a set of 22-in. electrically driven rolls and over a mandrel until the proper diameter and thickness are obtained.

The tube is then transferred to an expanding mill and thence through reeling mills from which it goes to a sizing mill where it is brought to final size according to specifications. If the size is found to be above specifications, the tube is passed through a continuous heating furnace and then through an electrically operated continuous reducing mill, which is expected to bring it up to the size called for in the order.

Every tube is inspected for wall thickness and interior imperfections, which is done by holding an electric lamp at one end while the inspector looks in from the other.

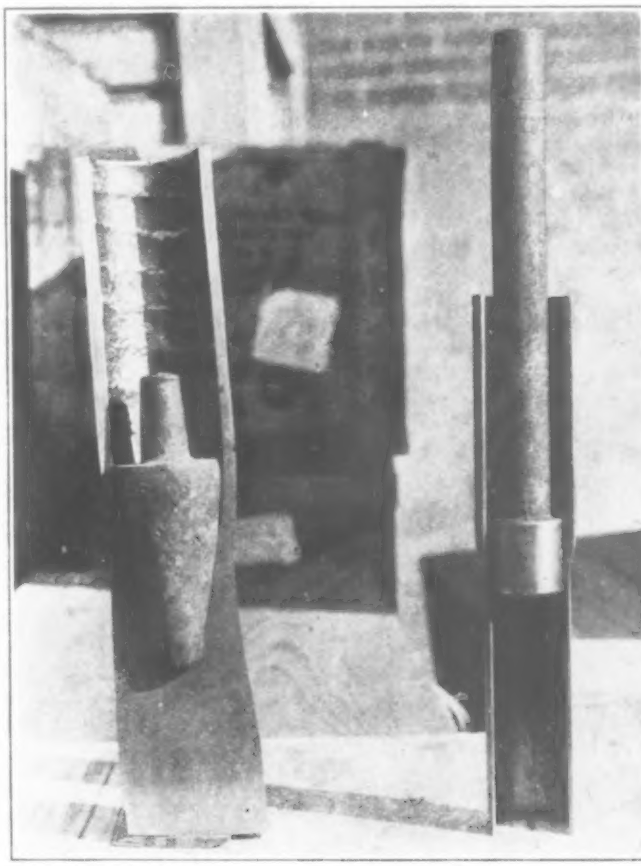

Fig. 14 Section of Solid Steel Bar During the Piercing Process (Left) and Section of Tubing During the Cold-Drawing Process (Right)

Another section of the plant takes care of the production of cold-drawn tubing. In this process one end of the tubes is heated in a gas-fired electric furnace and the heated end is pointed by means of a Yeakley-type power hammer. The tubes are then pickled in a solution of sulphuric acid and rinsed in water in order to remove as far as possible all scale which adheres to the surface. A lubricant is then applied to the surface of the tube after which it is passed over a shafting and fed into a die. It is then drawn to the size called for in the order. The drawing machines are both of the single-chain and double-chain types.

The drawing makes the tube extremely hard and brittle, so that it becomes necessary to put it through a process of annealing. Tubing intended for mechanical purposes is given only a slight anneal, while boiler tubing is made fairly soft. (*The Iron Trade Review*, vol. 64, no. 4, January 23, 1919, pages 259-264, 11 figs., *d*)

MOTOR-CAR ENGINEERING

Steam Agricultural Tractors, Dahme (*Zeitschrift des Vereines Deutscher Ingenieure*, Nov. 16, 1918). This article, which is well illustrated and is to be concluded in another issue, describes the latest road tractors constructed by the firm of R. Wolf, A.-G., in Magdeburg.

The boiler is tubular and is designed for pressures up to 10 atmos. The superheater is in the smokebox and consists of a large number of vertical spiral wrought-iron tubes of small diameter, which are set in parallel groups and through which the steam passes, flowing in a direction opposite to the passage of the exhaust gases to the smokestack. Steam temperatures up to 350 deg. can by means of this superheater easily be obtained.

The superheater and the boiler tubes are cleaned by means of a number of small steam jets playing into the smokebox in both directions, which effectually remove all matter adhering to the tubes.

The bunker is of sufficient size to take fuel and water for a 20- to 30-km. run, and the engine is supplied with a steam-jet suction pump for procuring the water en route.

The control of the engine is so arranged that it can be driven forward or reversed by the movement of a single lever. The steam supply is automatically controlled for hills, so that it is increased for ascending and decreased for descending. This arrangement can be put out of action whenever a very heavy load is being hauled, by the adjustment of a single screw.

In running this tractor as a stationary engine a great advantage is the fact that it runs as satisfactorily on the reverse as the direct, and, in consequence, crossed belts can be eliminated, and the automatic control is a great assistance in dealing with sudden intermittent heavy loads.

These engines are equally suitable for all kinds of road traction, driving sawmills, threshing machines, and the like. (*Technical Supplement to the Review of the Foreign Press*, London, vol. 3, no. 1, Jan. 7, 1919, no. 3746, p. 7)

POWER PLANTS

Elimination of Oil and Air from Feedwater (*De Ingenieur*, Nov. 9, 1918). In a paper read before the Department of Marine Engineers of the Royal Institution of Dutch Engineers by J. C. Dijxhoom, the importance of perfectly clean feedwater for steam boilers is dealt with. The presence of cylinder lubricating oil in the condensed water is always a likely source of trouble. Numerous devices are resorted to in order to overcome this, as, for instance, trays with suitable porous material through which the water can move forward and backward while the oil is deposited on the material; coke filters, in which the oil adheres to the surface of the coke; or pressure filters, in which the contaminated water is forced through filter cloths which retain the oil.

None of these appliances have succeeded in completely removing the oil, because it is in an emulsive state and divided into globules of less than 0.001 mm. diameter, which can pass through the finest filtering medium. Various precipitants are mentioned, but success depends in every case on subsequent filtration of the water through large sand filters.

The tiny globules of oil can be made to coalesce by passing an electric current through the water, and the author describes an apparatus he has designed for this purpose, using continuous current at 110 volts while the water flows through the feed pipe. The electrically treated water is then sent through a pressure filter consisting of perforated cylinders covered with cloth and enclosed in a strong vessel provided with inlet and outlet stop valves. Such a filter has very little effect on ordinary feedwater, but, as the electric process described above causes the oil globules to coalesce, the whole of the oil is effectively retained, leaving pure water only to pass through.

A pressure gage on the filter indicates the condition of the filter cloth, which must be changed when the pressure rises much above boiler pressure. It is also important to remove the air from feedwater, and the author describes a special apparatus he has designed which automatically accomplishes this. (*Technical Supplement to the Review of the Foreign Press*, London, vol. 3, no. 1, Jan. 7, 1919, no. 3760, p. 10)

Elimination and Recovery of Oil from Feedwater. (*De Ingenieur*, Nov. 30, 1918). An account is given of an oil-recovery plant used at the Central Station in Flushing. It is similar to the Perrett plant used in England during the last 15 or 20 years. The feedwater is first allowed to flow through a brickwork tank having baffle plates with openings at the bottom, while the oil which rises between the plates is removed through a valve and freed from water and dirt by being passed through a centrifugal separator.

The feedwater is then conducted to a second tank fitted with metallic baffle plates charged with continuous current at a pressure of 8 volts. Emulsified oil again separates as a layer between the plates, and can be recovered as before. The feedwater is finally passed through a coarse filter, which removes the last traces of oil. (*Technical Supplement to the Review of the Foreign Press*, London, vol. 3, no. 2, Jan. 21, 1919, no. 3905, p. 41)

RAILROAD ENGINEERING

Heavier 2-10-2 Type Locomotives Built for the Pennsylvania Lines. Description of the locomotives built for the Pennsylvania Lines West of Pittsburgh by the American Locomotive Company. These locomotives are notable for two reasons: First, the total weight is greater than that of any engines of this type previously built and yet they are able to operate on 23-deg. curves. Next, they are equipped with pilots capable of meeting requirements for road or yard service. Also these locomotives are extremely heavy though they are to be used on a division with low grades. Locomotives with five coupled pairs of driving wheels and a lateral-motion driving box on the front axle cannot traverse curves sharper than 16 deg., and the present locomotives had to be equipped with the Woodward floating axle on the front and rear drivers to enable them to pass 23-deg. curves.

The equalizing system is considered to be a very unusual departure from standard American practice, namely, a four-point suspension. The leading truck is equalized with the front driving wheels; the three center drivers on each side are equalized together and the rear drivers are equalized with the trailing truck. The valve motion, which is of the Walschaerts type, has an extremely long travel which is secured without excessive angularity by the use of a long radius rod and a long link combined with an eccentric crank of large throw. This gives a travel of $8\frac{1}{2}$ in. The experience with consolidation locomotives has shown that the theoretical advantage of long valve travel is borne out in actual practice.

It is interesting to note that tubes of $2\frac{1}{2}$ in. diameter are used in the boiler. It is stated, in this connection, that while the total heating surface is decreased by the use of such large tubes, experiments have demonstrated that as tubes are lengthened beyond a certain point the evaporation does not increase proportionately. The most desirable ratio of length to internal diameter is approximately 100, such a ratio being secured in this instance by the use of $2\frac{1}{2}$-in. tubes. (*Railway Age*, vol. 66, no. 4, January 24, 1919, pp. 249-251, 3 figs., *d*)

New Departure in Firebox Construction. Description of an installation recently tested out on a Chicago, Milwaukee & St. Paul locomotive designed by the Nicholson Firebox Company, of Chicago, Ill.

The installation as shown in Fig. 15 is called a thermic siphon and is so disposed as to displace the arch tubes hitherto depended on to support the firebrick. Each element consists of an approximately square plate of firebox steel folded on itself along a diagonal in such a manner as to resemble a flattened cornucopia. The lower extremity of the siphon is flanged into tubular shape and is inserted into and secured to a throat sheet of the firebox, giving to the tubular portion a slope corresponding to that of the customary arch tube.

The purpose of the use of thermic siphons is double: namely, to utilize to better advantage the radiant heat transfer available, and to accelerate the water circulation within the boiler.

Practically all of the heat absorbed by the heating surfaces of the ordinary firebox is radiated from the fuel bed and from the flames to the heating surface. The siphons break up the flame into several channels, thereby increasing the flame radiating surface, which is equivalent to increasing the firebox heating surface, so that with the same flame temperature a greater quantity of heat may be radiated to the surfaces of a firebox thus equipped.

Referring to Fig. 16, it appears that firebox *B* equipped with the siphons evaporated approximately 5000 lb. per hour more than firebox *A*. While the shape of the flame passages in *B* would tend to increase the heat absorption from the hot gases by direct contact or convection, the amount of heat so absorbed would still be very small compared to the amount of radiant heat absorbed from the flames.

The second purpose of the use of the flame siphons is that of increasing the amount of water circulation. The volume of water circulated through a pipe, such as an arch tube exposed to the high firebox temperatures, seems to be greatest when the volume of water and steam discharged at the outlet are about equal, and this condition prevails when high firebox temperatures are obtained. The ratio of the average cross-sectional area of the water passage of the siphon to the perimeter, or the heating surface, is practically the same as that of an arch tube, and it is reasonable to suppose that under similar conditions of temperature the proportion of water and steam discharged would be the same. Assuming, however, that under normal conditions of working and firebox temperatures, the steam leaving the outlet of the siphon carried with it only half its volume of water, the circulation through the two siphons is found to be sufficient to cause all of the water in the boiler to pass through them every five minutes, and at the highest rate of working the velocity of circulation practically would be doubled.

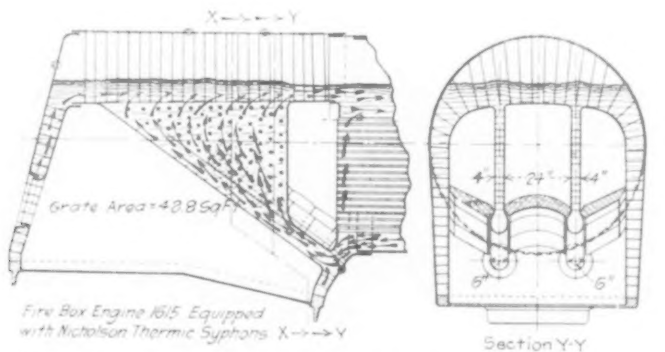

Fig. 15 General Arrangement and Scheme of Operation of the Nicholson Thermic Siphon for Locomotive Boilers

With such high velocity of circulation as is here indicated and with such large volume of water siphoned through the inlets in such a short space of time, it is apparent that no cold water could collect in the belly of the boiler, or remain there long.

The siphons are located so as to take advantage of the natural trend of circulation in the boiler and give greatly added velocity to it. The cold water fed in finds its way to the bottom of the boiler and slowly travels back toward the firebox. The siphons draw their water supply from this ordinarily cold zone at such a rapid rate that the cold water fed in is quickly drawn back to the throat and siphoned through the hottest zone of the firebox where it is heated up to the temperatures of the steam and partly evaporated.

The water at steam temperature discharged from the top of the siphons travels forward toward the front flue sheet, thereby tending to draw the cold water up from the bottom of the side and back water legs. Under such conditions of circulation the water is maintained at a nearly uniform temperature throughout the boiler, and this should result in a marked decrease in the prevalent boiler troubles due to the unequal contraction and expansion caused by wide variations in the temperature of the water in different parts of the boiler.

The article describes in some detail and illustrates the method of attaching the siphons. (*Railway Review*, vol. 64, no. 2, Jan. 11, 1919, pp. 47-51, 5 figs., *d*)

Three-Cylinder Locomotive for Constantinople (*Zeitschrift des Vereines Deutscher Ingenieure*, Nov. 9, 1918). A ten-coupled three-cylinder goods locomotive supplied to the Constantinople Military Authorities, by Henschel, of Cassel, is described and illustrated. The advantage of the three-cylinder type over the two- or four-cylinder types, especially for goods locomotives, are clearly pointed out. Tests were made with two three-cylinder locomotives, one with all three cylinders horizontal and the other with the two outer cylinders horizontal and the middle one inclined upward at 1 to 6.143. By having three cylinders, the large diameter (686 mm.) required for a two-cylinder engine was avoided. The starting of the three-cylinder type is better owing to the distribution of the turning force on the three-crank axle, and the draft on the fire is more regular owing to the 50 per cent increase in the number of the exhaust blasts. The angle of 120 deg. between the cranks as obtained on the three-cylinder engine is the most efficient turning angle.

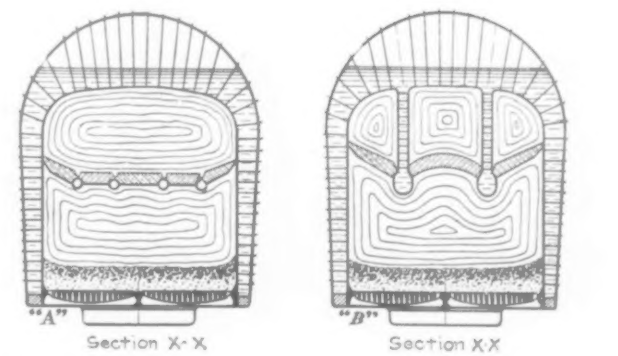

Fig 16 Flame Radiation in Locomotive Fireboxes with and without the Use of Nicholson Thermic Siphon

The locomotive was designed for a maximum speed of 45 km. per hr. and to pull 500 tons up a gradient of 1 in 20 at a speed of 15 km. per hr. The leading dimensions are as follows:

Cylinders, diameter	560 mm.	Adhesive weight	78,600 kg.
Piston stroke	600 mm.	Tender wheels, diameter	1,018 mm.
Driving wheels, diameter	1,250 mm.	Tender wheelbase	3,300 mm.
Leading wheels	820 mm.	Tender water capacity	12 cu. m.
Total wheelbase	8,500 mm.	Tender coal	7,000 kg.
Total boiler pressure	13 kg. per sq. cm.	Tender weight empty	18,170 kg.
Area of grate	4½ sq. m.	Tender weight loaded	37,170 kg.
Heating surface of firebox	16.13 sq. m.	Total wheelbase for locomotive and tender	15,000 mm.
Heating surface of tubes	225.22 sq. m.	Overall length of locomotive and tender	18,235 mm.
Heating surface of superheater	80.88 sq.m.		
Weight empty	82,560 kg.		
Weight loaded	91,290 kg.		

The engine has 80 mm. sideplay each side on the front wheels and 25 mm. on the second and fifth coupled wheels for turning curves. The center line of the middle inclined cylinder passes 100 mm. vertically above the center line of the crankshaft. The two outside cranks are set at an angle of 120 deg. to each other, and the middle crank at an angle of 130 deg. 31 min. to the right-hand crank and 108 deg. 29 min. to the left-hand crank.

Ten of these locomotives were supplied to the Military Authorities at Constantinople. Several goods and passenger engines of the type have been supplied to the Prussian State Railways. (*Technical Supplement to the Review of the Foreign Press*, London, vol. 3, no. 1, Jan. 7, 1919, no. 3747, pp. 7-8)

Articles appearing in the Survey are classified as *c* comparative; *d* descriptive; *e* experimental; *g* general; *h* historical; *m* mathematical; *p* practical; *s* statistical; *t* theoretical. Articles of especial merit are rated *A* by the reviewer.

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Contributions of interest to the profession are solicited. Communications should be addressed to the Editor.

The House passed a bill on February 18 extending the life of the Screw Thread Commission for one year. The matter at this writing is now in the Senate for approval. The commission, it will be remembered, was appointed for six months in October, 1918, by the Secretary of Commerce. While its work has advanced to a point where a tentative report is being prepared, the added time is much needed for the proper completion of so important and intricate a matter.

Two of our best-known engineers and educators, a president and a past-president of this Society, one a dean of colleges of engineering and the other a president of a technical institute, have recently made addresses bearing on the future of the engineer and on what he must expect to do and become, and what viewpoint would seem to be necessary if he is to live up to his full duties and responsibilities. One address was made at Detroit by President Cooley and the other at Ottawa by Past-President Hollis. While in treatment they are different, in their application they point in the same direction, toward the service of the public. Both addresses are reported in this number, the one by Dean Cooley under what he styles " one of the finest titles I ever worked out "—An Unoccupied Rung in the Engineer's Ladder of Fame—and the one by Dr. Hollis under News of the Engineering Societies. Read them.

The headquarters [illegible] A.S.M.E. is favored with frequent visits of members [illegible] are either returning from France or are on their way o[illegible]s. Recently Major W. B. Gregory, of New Orleans, a member of the Council, returned after 16 months' absence, having been engaged mainly in waterworks construction for supplying the railway lines leading to the western front.

Major Gregory speaks appreciatively of the cordial relations which he experienced among the French people with whom he came in contact; of their appreciation of the service rendered by the Americans; and of their desire to show their gratitude by such means as are at their disposal.

Another visitor was Prof. E. R. Hedrick, of the University of Missouri, who is now on his way abroad to take charge of instruction in mathematics as applied to engineering among the A. E. F. Professor Hedrick will work under the direction of Dean L. E. Reber, Mem.Am.Soc.M.E., of the University of Wisconsin, who is in control of the engineering and trade courses for the soldiers. A brief account of this educational work is given in another column of this issue.

The Spring Meeting

The Spring Meeting, to be held June 16 to 19 at Detroit, with headquarters at the Hotel Statler, will have as its leading professional feature an all-day session devoted to the subject of industrial research—a subject which has received a great impetus in this country in consequence of the war and the necessary and unusual development of certain of our industries. Other features will be a report of the Aims and Organization Committee whose work is attracting widespread attention among the Sections of the Society, and a session conducted by the Detroit Local Committee and the Committees of the various Mid-Western Sections.

One session will be devoted to a survey of industrial relations, taking up certain aspects of labor conditions and covering employees' service. At least two sessions will be devoted to general technical papers. Particulars about excursions and social features cannot at this time be given, but it is needless to say that the wonderful resources of Detroit will be at the disposal of the members and their friends who attend the meeting.

Don't forget the Spring Meeting—June 16 to 19—when so many matters of vital interest to the profession and to the members individually will be discussed at this critical time in our history. Note that the meeting opens on *Monday*, June 16, instead of Tuesday, as has been usual.

Secretary's Letter

THE outstanding note throughout the country in this present period of uncertainty and unrest is that of optimism. During an extended trip among the Sections of the A. S. M. E., which has just been concluded, I have followed a path through the Central States to Chicago, then through the South Atlantic States and west to Oklahoma and up to the northern border. Everywhere this feeling of optimism is evident. I have yet to find one man, engineer or man of business, who does not think the cycle of temporary business depression will be completed during this calendar year; the majority say in six months, and not a few predict a shortage of labor within three months. I have been informed of contracts actually let for large increases in plants of certain industries, to be begun as soon as weather permits.

This condition in business obviously is reflected in the outlook for the work of the societies, local and national. I mention local first because I am unreservedly for developing and supporting the local society first of all. After one has done his full duty locally then he may join that national society which best serves his specialty.

Further, all local societies can depend on the support of our national organizations in charging the members to bear their full share of the work of maintaining professional interest in their communities. The best means for effecting such coöperation is for our Sections, and the sections of all the other national societies, to head up in the local society. As soon as this is accomplished in every locality we will have a truly national spirit and a community of interest.

The usefulness of the local organizations in public affairs is illustrated by action taken recently by the Associated Engineering Societies of St. Louis under the auspices of the Engineers' Club with reference to the proposed municipal bond issue of that city. Most of this bond issue is for engineering projects and consequently the engineer-citizen is vitally interested. At a meeting held to discuss the subject the civic committee of the Engineers'

Club participated, and there was very evident interest on the part of all in attendance.

The one great necessity in the industrial prosperity of the nation is research and more research. Indeed, if we are even to survive, much less excel, in the competition which is to come, we must reduce the unit cost to manufacture, and one of the potent means of doing this is to conduct adequate researches. For example, with the high wages and low efficiency of the present time, and with ships costing from two and a half to three times what other countries are paying, how can we endure unless we develop processes which will insure quantity production?

This work is peculiarly within the province of the engineer, and there is no more important undertaking under way by the different professional societies than that of their research committees. The development of the research attitude of mind throughout the nation should command our instant attention, and the desirability of a research department in every industry may well be emphasized.

This work must be done today. Tomorrow will be too late. The A. S. M. E., through its Research Committee, stands ready not only to act as a clearing house, but to take the initiative and, modestly at first, but nevertheless definitely, to make grants for promising research, when such is for the common good.

The National Research Council is to head up all the research work in the nation, and this Society is working hand in glove with the National Research Council in that field which is peculiarly ours.

An important adjunct in his work, in fact its predecessor, is our Library Service. Our joint libraries, comprising the best collection of technical books and periodicals on this continent, is literally "at your service." It has a large staff of trained searchers. It has been found that 40 per cent of all problems have already been solved by some one. Save time and money. Consult *your* library.

In this connection, I wish to congratulate the American Society of Heating and Ventilating Engineers for its vision and enterprise in undertaking research as a Society. Its plan contemplates the collection of a fund of $20,000 a year for five years to carry on this work.

Hand in hand with research is standardization. Our newly formed American Engineering Standards Committee, representing the several departments of the Government and the leading engineering societies, and paralleling the organization of the British Engineering Standards Association, bids fair soon to play its important rôle. Our Society has appointed as one of its representatives on the American Engineering Standards Committee the Canadian representative of the British Engineering Standardization Association, who is a member of our Society, to assure ourselves of the most complete coöperation.

Looking out into a still broader field we find that through the selection of a Washington representative by the Engineering Council (representing the societies in their relations with the public) we are fast taking on activities closely related to the life of the nation.

Another joint activity of the societies, operating under the auspices of the Engineering Council, is the Engineering Societies Employment Bureau. This service is just now in great demand—150 professional men daily seeking positions. In order that we may function more effectively in this activity, we need branches of this Bureau in each city. Will you assist?

Calvin W. Rice,
Secretary.

Council Meeting, February 22

A regular meeting of the Council was held in Pittsburgh, Pa., on February 22. On the morning of the day of the meeting an inspection trip was made to Dr. John A. Brashear's observatory and shops, which was followed by luncheon at the Duquesne Club. The Council meeting was held at 2:00 p. m. in the rooms of the Engineers' Society of Western Pennsylvania. An account of the business transacted at this meeting will appear in the April issue of Mechanical Engineering.

In the evening a public dinner, preceded by an informal reception, was held at the William Penn Hotel, to which all members of the Society in Pittsburgh and vicinity were invited. Among the speakers were Dr. John A. Brashear, Past-President and Honorary Member, Am.Soc.M.E., President Mortimer E. Cooley and George H. Neilson, President of the Engineers' Society of Western Pennsylvania.

Washington Office Opened by Engineering Council

A National Service Committee has recently been organized by the Engineering Council, having for its general purpose to seek out public services which may be best performed by engineering societies and to offer the proper men for such services; to speak authoritatively for the Council before committees of Congress and Governmental departments; and to supply first-hand information to engineers and their organizations regarding pending legislation.

M. O. Leighton
Chairman National Service Committee, Engineering Council, and Manager of Washington Office

The chairman of the Committee is Marshall O. Leighton, consulting engineer, Washington, D. C., under whose direction a Washington office for the Council has been opened at 502 McLachlen Building, Tenth and G Streets. The personnel of the Committee is representative of engineers throughout the country and comprises, besides the Chairman, the following men: C. B. Burdick, Chicago; George F. Swain, Boston; Philip N. Moore, St. Louis; L. D. Ricketts, Warren, Ariz.; Andrew M. Hunt, San Francisco and New York; Andrew M. Lockett, New Orleans; W. C. L. Eglin, Philadelphia, and Bancroft Gherardi.

Mr. Leighton, the Chairman, was graduated from Massachusetts Institute of Technology and has been a practicing sanitary engineer and consulting expert. He was connected with the Government in the U. S. Geological Survey for about eleven years and has been engaged in various public works, such as river hydraulics, water power, sewerage pollution, etc.

Discharged Engineers of P[illegible] Service Commission, New York, N[illegible]einstated

At the January meeting of the New York Section, as reported in the February issue of Mechanical Engineering, Mr. Charles Whiting Baker, Mem.Am.Soc.M.E., called attention to the action of the Board of Estimate and Apportionment in New York City, in the abrupt dismissal of some 370 engineers of the Public Service Commission of the city. In consequence of this drastic action, the Engineering Council, representing the Civil, Mining, Mechanical and Electrical Engineers, arranged a hearing on the

afternoon of January 14 in the Engineering Societies Building, New York, at which various representatives of city departments and of associations interested were present.

It developed that the Board of Estimate and Apportionment had adopted in December what is called a "line budget" the provisions of which led to the discharge of the engineers, but against whom no charges were made. In view of the facts developed at the hearing and the very evident curtailment of construction and disruption of a highly organized staff which would occur if the order were allowed to stand, the Engineering Council passed the following resolution:

RESOLVED, that in view of the above facts, the Board of Estimate and Apportionment be urged to reconsider at once its action of December 30 and to make such appropriation as will enable the Public Service Commission to carry on with safety and economy the rapid completion of the subway work, and that the Board of Estimate should leave to the Public Service Commission, on which the law places the responsibility, the detailed apportionment of these funds in accordance with a practical schedule to be prepared by it and submitted to the Board of Estimate for its information.

It is a pleasure to report that announcement was made on January 31 that the discharged employees had been reinstated, an appropriation having been made at the instance of the Board of Estimate and Apportionment sufficient to maintain the organization for the months of February and March.

Educational Work of Our Army Abroad

A great deal of interest is evidenced, both among engineers and educators, in the remarkable educational work of the A. E. F. abroad. This work has been developed under the efficient management of the Army Educational Commission of the Y. M. C. A., which has the direction of the courses of study and the selection of the personnel of the instructing staff.

The administration of the work, in so far as it is necessary for the Army to coöperate with the Commission of the Y. M. C. A. for its effective handling, is in charge of the General Headquarters abroad. General Robert I. Rees, who was recently Chairman of the Committee on Education and Special Training of the War Department, is now overseas in charge of arrangements for the military coöperation.

The work of the Army Educational Commission of the Y. M. C. A. in this country is directed by Dr. James Sullivan of the Department of Education of New York State; and by Samuel C. Fairley, Associate Home Director. Abroad, the work is directed by a Commission consisting of Dr. John Erskin, of Columbia University, *Chairman;* Dr. Frank E. Spaulding, Superintendent of Schools of Cleveland, Ohio; and Kenyon L. Butterfield, President of the Massachusetts Agricultural College.

Instruction is to be given at the various camps and at certain of the schools and colleges. The soldiers are to have the option of either five hours' drill or two hours' drill and three hours' educational work per day. Already 18,000 men are taking courses in the various departments. An idea of the extent of the project are expected to take courses of three months' duration in higher subjects at the various universities and colleges of France and Great Britain.

It is expected that at least half of the educational work will be of the vocational type, which is under the direction of Dean L. E. Reber, Mem.Am.Soc.M.E., of the University of Wisconsin, who has lately been in war work with the Emergency Fleet Corporation in Philadelphia. Assisting him are Dean W. H. Kenerson, Mem.Am.Soc.M.E., of Brown University; Prof. Frank C. Theissen, of the University of Wisconsin; Prof. E. R. Hedrick, Mem. Am.Soc.M.E., of the University of Missouri, and a number of other specialists.

The Y. M. C. A. has been conducting a recruiting campaign to secure educational executives, and as a result of its efforts more than two hundred men have sailed and one hundred and fifty are ready for sailing. A million and a half of textbooks and pamphlets valued at one and a quarter million dollars have been shipped already by the Y. M. C. A. for distribution among the soldiers.

Engineering Council Acts on Public-Works Control

A joint meeting of the Reconstruction, Public Affairs and National Service Committees of the Engineering Council was held on January 28 to consider what action should be taken relative to legislation affecting the supervision of national public works. The importance of the matter is evident from the fact that the value of construction work undertaken for the war, in the way of docks, hospitals, storehouses, railroads, water-supply systems, etc., aggregated $800,000,000 and that *every year* many million dollars' worth of engineering works are constructed, operated and maintained by the numerous bureaus and departments of the Government.

The war work mentioned has been carried on under the direction of the Construction Division, reporting directly to the General Staff of the Army. This division was recruited largely from engineers in civil life, 90 per cent of whom probably went into the work at a personal sacrifice. The law is such that 90 days after peace is declared the Construction Division must go out of existence.

One item of legislation referred to is an amendment of the Military Appropriation Bill providing for the continuance of the Construction Division and its permanent establishment as the Construction Corps, to have charge of the property which it has constructed, including completion, operation, maintenance and demolition.

Another item is the Kenyon Bill, S. 5397, which would create an Emergency Public Works Board "to coöperate with all federal, state and municipal agencies entrusted with the execution of public works, and to stabilize industrial and employment conditions during the period of demobilization." The bill carries a special appropriation of $100,000,000 and provides for further advances by the War Finance Corporation not to exceed an aggregate of $300,000,000 under the terms stipulated in detail and under control of the Secretary of Labor in conjunction with the Emergency Public Works Board. This bill as originally drafted gives the Engineer Corps of the U. S. Army a large measure of control in the civilian works to be constructed under the terms of the act.

It was the sense of the conference of the committees of Engineering Council that the legislation providing for the Construction Corps should be supported, but that the Kenyon Bill should be materially modified before its passage could be supported by engineers.

From Col. Elliott H. Whitlock

Col. Elliott H. Whitlock, former member of the Council of the A. S. M. E., writes from Toul, France, under date of December 27, 1918, as follows:

Soon after the first of October I was relieved from my work at the Engineering Depot at Is-sur-Tille and sent to the Second Army to join my regiment at Toul. I found our Colonel here in the Chief's office as Executive Officer and I was made Supply Officer for the army, with our regiment scattered all about the front, in charge of the depots and parks and also doing a lot of shop work.

We soon got some more machinery up here and put up a couple of good-sized shops where we could handle pretty good-sized jobs, machine, carpenter and blacksmith. I usually spent one day in the office and the next going out around the different places.

We got our engineering materials out in large quantities and placed well up to the front ready for the drive that started on November 10, so we were all ready to go forward; and then the armistice was signed on the eleventh and fighting stopped at eleven o'clock on that morning, and now we are hauling all that stuff back to the depots.

Part of our regiment were transferred to the Third Army, known as the Army of Occupation, and we soon started for Germany. That was a very interesting trip, for we passed over the old front lines of both sides and on up into Luxemburg and then across to Prussia. It was a grand sight to see the American troops by the thousands marching across the Moselle River bridges

into the enemy territory that Sunday morning, and an inspiring one, especially to those of us who had been so closely in touch with things for the past few months.

And now our regiment is all back here with the Second Army again, helping straighten out things and get the materials together, and the machines brought back to the depots so it will be in good shape to move; and what is more, we do not care how soon this is finished and the word comes to get ready to go home, for there is not a one of us but is anxious to shake this country and set foot on good old U. S. A. soil again. And I guess the most of us will agree with the fellow who, after landing in N. Y., said, "The Statue of Liberty will have to turn around if she ever wants to look me in the face again."

Request for Correct Addresses

The names listed below are those of members of the Society whose addresses are either unknown or upon which there is doubt. The Secretary will be pleased to receive information regarding the present addresses of these members.

ADDRESS UNKNOWN

Barry, John L.
I. C. Green.
Robert M. Hale.
J. J. de Kinder.
James L. Kirsch.
Samuel F. McIntosh.
George P. Marrow.
Sir Charles H. A. F. L. Ross.

ADDRESS DOUBTFUL

Chalmers B. Boles, c/o Wilson & Co., 71st St. and Ashland Ave., Chicago, Ill.
Capt. George S. Brady, 613 G St., N. W., Washington, D. C.
Lieut. Col. H. M. Byllesby, 1607 H St., N. W., Washington, D. C.
William W. Chace, Amesbury Apt., 18103 Canterbury Rd., Cleveland, O.
David P. Clemmer, U. S. S. B., 72 W. Adams St., Chicago, Ill.
Benjamin J. Cline, c/o Holt Mfg. Co., Peoria, Ill.
William H. Doron, c/o The Barrett Co., 17 Battery Pl., New York, N. Y.
Hugh H. Hargrave, 2238 Cecil Ave., Baltimore, Md.
First Lieut. William Knight, 509 W. 174th St., New York, N. Y.
Ragnvald Naess, Philippine Vegetable Oil Co., Inc., 608 Fife Bldg., San Francisco, Cal.
Capt. Burritt A. Parks, 509 Grand Rapids Saving Bldg., Grand Rapids, Mich.
Harold D. Root, 277 N. 20th St., East Orange, N. J.
Herbert S. Selindh, Holly Sugar Corpn., Swink, Colo.
Capt. Alexander C. Sladky, 892 14th St., Milwaukee, Wis.
E. Platt Stratton, 80 Broad St., New York, N. Y.
Capt. John Weber, 4413 15th St., N. W., Washington, D. C.
James J. Zimmerman, 313 South St., Johnstown, Pa.

Prize Essay Contest in Industrial Economics

The National Industrial Conference Board, Magnus W. Alexander, Mem.Am.Soc.M.E., Managing Director, offers a prize of one thousand dollars for the best monograph on any one of the following subjects:

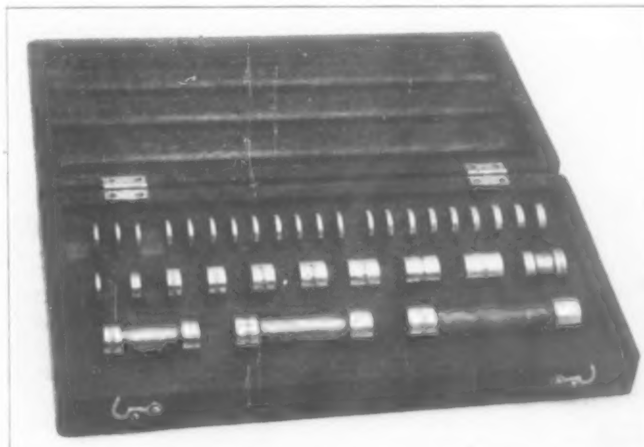
1 A practicable plan for representation of workers in determining conditions of work and for prevention of industrial disputes.
2 The major causes of unemployment and how to minimize them.
3 How can efficiency of workers be so increased as to make high wage rates economically practicable?
4 Should the State interfere in the determination of wage rates?
5 Should rates of wages be definitely based on the cost of living?
6 How can present systems of wage payments be so perfected and supplemented as to be most conducive to individual efficiency and to the contentment of workers?
7 The closed union shop *versus* the open shop: their social and economic value compared.
8 Should trade unions and employers' associations be made legally responsible?

The Committee of Award is composed of Frederick P. Fish, Chairman of the National Industrial Conference Board; Dr. Jacob Gould Schurman; Henry R. Towne, Past-President, Am.Soc.M.E.

Manuscripts, to be considered in the contest, must be mailed on or before July 1, 1919, to the National Industrial Conference Board, 15 Beacon Street, Boston, Mass., marked "For Prize Essay Contest in Industrial Economics."

Manufacture of Precision Gage Blocks at the Bureau of Standards

During the annual meeting of the A.S.M.E. in December, 1918, the demonstration conducted in the Branch Gage Section of the Bureau of Standards, in the Engineering Societies Building, New York, showing the utility of the light-wave interference method for measuring the precision gage blocks being made at the Bureau of Standards, attracted the attention of many members of the Society. The unheard-of accuracy with which these blocks were being produced, and the accuracy and facility with which comparisons of length, tests of flatness and parallelism were made by the interference method, resulted in many comments upon the method both as being novel and of particular interest.



SET OF GAGE BLOCKS MADE BY THE BUREAU OF STANDARDS

It is possible to produce these commercially to the remarkable accuracy of five millionths of an inch for length, flatness and parallelism through the use of the light-wave interference method of measurement

At that time there were exhibited several different sizes of precision gages which had been completed by the Bureau. Those who were fortunate enough to visit the Branch Laboratory will recall that the blocks produced are of a cylindrical shape rather than a prismatic shape, as are the similar Swedish gages. The blocks are made cylindrical rather than prismatic for the reason that greater wearing surface is secured, additional applications for direct measurement are possible, and the cylindrical shape is more economically manufactured.

There is shown in the accompanying illustration one of several sets of the cylindrical blocks which have been completed by the Bureau of Standards. The various blocks of these sets are being produced commercially to within an accuracy of 0.000005 in. for length, flatness and parallelism of the end surfaces. It has been found comparatively easy to hold the flatness and parallelism of the blocks to within about two millionths of an inch; and with special care absolute length may be held within this accuracy. However, for commercial sets the limit of five millionths of an inch mentioned above is deemed satisfactory.

The manufacture of these precision gage blocks is being carried out by the Gage Section, Bureau of Standards, in collaboration with the Engineering Division, Ordnance Department, U. S. A. When it is considered that there has been developed in a period of about six months the art of making gage blocks more accurate than those heretofore obtainable only in Sweden, where the manufacture has been carried on for 10 or 15 years as a secret process, the achievement represented in the development of the process for manufacturing these gages commercially will be realized.

The success in the development of the manufacture of the precision gage blocks on a commercial basis has been due largely to the efforts of Mr. H. L. Van Keuren, Mem.Am.Soc.M.E., Chief of the Gage Section, Bureau of Standards; Lieut.-Col. E. C. Peek, Head of the Gage Section, Engineering Division, Ordnance Department; and the inventor, Major William E. Hoke, Gage Section, Engineering Division, Ordnance Department. In addition, the facilities of the Optical Division and Metallurgical Division of the Bureau of Standards, and the full coöperation extended by Dr. S. W. Stratton, Director of the Bureau of Standards, has made it possible to realize a very rapid progress in overcoming unforeseen obstacles and securing blocks extremely accurate in flatness, parallelism and length.

Machine-Gun Cooling Problem

The Inventions Section of the General Staff is desirous of obtaining a solution of the problem of improving the methods of cooling machine guns during continuous fire, and the prevention of the freezing of the cooling liquid during cold weather when the gun is not in use.

At present the ordinary water-cooling system is used. It is necessary to transport several boxes of water for each gun in the field, as the water in the cooling jacket quickly turns into steam during firing. The following points should be observed in the solution of this problem:

1 It should be easily obtainable
2 It should be easily carried
3 It must not be too expensive
4 It must not injure the metal parts of the gun
5 If possible, it should be capable of being used several times so as to avoid extra weight
6 A minimum of waste during use should be obtained.

It must not be assumed from the above that a cooling system for machine guns must necessarily follow the lines of the present water-filled jacket. Any efficient method of cooling will receive serious consideration.

Correspondence in regard to this matter should be addressed to the Inventions Section, General Staff, Army War College.

The Relation of an Engineering Society to the Training of Workers

Two letters of general interest to engineers have been received by Mr. L. C. Marburg, chairman of the Committee on Aims and Organization, relating to the present and future need for the training of industrial workers. That this is one of the greatest of industrial problems cannot be doubted, and it is contended by each of the writers that it should come within the aims and purposes of the "Society of the Industries." We are informed by Mr. Marburg that, as a matter of fact, his committee expects to take up the subject of better training for industrial workers under heading A5 of the program entitled Education and Special Training. Quotations from the two letters follow:

U. S. DEPARTMENT OF LABOR
WASHINGTON, D. C.

I regret that you have not included in the outline of professional aims a paragraph relating to better training for industrial workers. Of what value are the most excellently conceived plans if there are not at hand men or women trained and sufficiently skilled to understand those plans, to appreciate their value and to execute them with efficiency and economy? As all students of development understand, this country has drifted into the habit of expecting to recruit its skilled labor from other lands and has not in any adequate manner made provision for replenishment of its supply of skilled workers. The rising wage scales and habits of other lands have dried up the stream of skilled-labor supply. Even before the war broke out practically no skilled labor was coming to America. Now we cannot expect that any will come for several years, and unless American industries set out with deliberate purpose and broad understanding to inculcate training, we may find ourselves some fine morning with work to execute and nobody to do it.

This is an engineer's job if I ever saw one; and only engineers with professional ethics, with a broad point of view, with cultivated understanding, can save the situation.

C. T. CLAYTON,
Director.

UNITED STATES SHIPPING BOARD
NEW YORK CITY

This seems to be a subject which should receive a great deal of attention from the A.S.M.E. There are, I believe, four distinct branches in which the Society could very profitably interest itself, and for which there is a distinct need for definite consideration on the part of a representative body:

1 Legislation for regulating the conducting of training work in factories, whereby it shall be kept up to certain standards and conducted on certain systematic and thoroughgoing principles, possibly first considering the actual need of men required in the industry in order that clashes may be avoided with organized labor.
2 Preparation of material for the conducting of this work.
3 In connection with No. 1 the determination and promotion of standard methods and utilization of qualified instructors.
4 Organization of instructors and directors of training committees.

In this connection may I point out that the work of the United States Shipping Board in education and special training has been confined mostly to the training of men to increase and cheapen production.[1] This has resolved itself into three definite branches of work:

1 The training of tradesmen, utilizing these men as instructors and giving to them the necessary instruction in order that they may become capable teachers. The one great weakness in any training scheme heretofore has been due to the fact that the ordinary tradesman is anything but a good teacher.
2 The training of foremen, particular stress being laid on the handling of men.
3 The giving of supplementary courses in evening schools and other public institutions, the information given being very closely tied up with the work done by the men in the yards.

The foregoing, of course, involved the utilization of a large number of men who were already trade teachers and the getting out of a large amount of instructional material. A few figures will enable one to gage more definitely the amount of work that has been accomplished in this district alone in connection with the shipbuilding program: Twenty staff instructors have been utilized (for training the skilled shipyard men to become instructors); 390 tradesmen have been trained as instructors; 500 foremen have received foremen training courses; 3000 students have received supplementary training in evening schools, and 15,000 men have been broken in as shipyard tradesmen by the organized training methods of the Fleet Corporation.

R. V. RICKFORD.
District Representative, Education and Training Section.

The Bureau of Standards Gage Laboratories

THE Gage Section of the Bureau of Standards has become known to a large number of American manufacturers who required limit gages in the production of interchangeable parts for munitions of war. There has been developed at the bureau an adequate organization, and the apparatus, equipment and methods in use are such as to permit the accurate and quick testing of various types of gages, including screw-thread plug and ring gages, profile gages and plain gages, as well as precision standards, measuring tools and apparatus.

In addition to the Gage Section at Washington, branch gage sections have been established in the Engineering Societies Building, 29 West 39th Street, New York City, in the Plymouth Building, 22nd and Prospect Avenue, Cleveland, Ohio, and in the Meigs Building, Bridgeport, Conn.

Up to the present time the gages tested by the Bureau have been either for departments of the Federal Government, or manufacturing concerns who were executing war contracts. In the last few weeks, however, quite a number of gages have been submitted by manufacturing concerns engaged in peace-time production. It is the desire of the Bureau to meet this situation as it is felt that the organization and apparatus developed for war purposes should be maintained for the benefit of manufacturers during peace times. The future possibilities of this work, however, depend entirely upon the coöperation secured from manufacturers. The future possibilities of this work depend entirely, however, upon the coöperation secured from manufacturers.

WORK OF THE TECHNICAL STAFF

In connection with the work of the technical staff there has been accumulated a vast amount of information and data on the

[1] Some interesting pictures and a somewhat more detailed account of the work are given in *International Marine Engineering*, January 1919.

construction, measurement and use of all kinds of gages, and it is planned to use the technical staff now available for the preparation of pamphlets, publications and other literature in order to make this information accessible to American manufacturers. Furthermore, the technical staff will be engaged in research work: on steel treatment and methods used in the manufacture of gages; in developing, perfecting, designing and constructing simple forms of measuring instruments for shop use; and in arranging formulæ, charts and methods of computation in simplified form for the use of toolmakers and gage makers.

For the work of the technical staff, as outlined above, where the results are of general utility to American manufacturers, no charge will be made for the service rendered.

Schedule of Fees for Gage Testing

A nominal fee will be charged, however, for the routine test of gages when the results of the test will be of benefit to but one or two parties. The amount of this fee will depend largely on whether the gage is one that is easily measured, or is a complicated gage requiring the expenditure of considerable effort in its test. The fee will be based upon the accuracy of the test desired. The following schedule of fees is proposed:

Plain plug gages	\$0.50 each
Plain ring gages	0.50 each
Snap gages	0.50 each
Flat or round-end standards or checks	0.50 each
Measurement of any one element, such as lead, angle, or diameter, of threaded plug gages	0.50 each
Measurement of lead or angle of threaded ring gages	0.50 each
Complete measurements of thread gages	1.00 each
Photographs of form of thread of threaded plug or threaded ring gages	0.25 each
Profile gages or fixtures	1.00 and up

(Depending upon the complexity.)

Such gages, instruments or tools as may be submitted for test should be accompanied with drawings or specifications with which they are supposed to conform in order to facilitate the test and to permit the reporting of the important dimensions of the gage submitted. Also, complete information should be included as to the route of the shipment of gages, the nature of the test desired, and the disposal of the gages after test.

Gage Shop

A gage shop was organized at the Bureau of Standards in Washington for the salvage of master gages and for the manufacture of master and inspection gages which were needed by the War Department for exigency purposes; such as to prevent stoppage of production, or for immediate use overseas. This shop, while not large, is equipped to manufacture all types of precision gages including precision end standards, profile gages, plug, snap and ring gages, and threaded plug and ring gages.

It is planned that this shop be used for the manufacture of such standard gages as may be required for certain apparatus, such as complete sets of standards for the use of the Government and American manufacturers, like those designated by the National Screw Thread Commission. These standards will be deposited in Washington, and possibly extra sets will be available at the branch laboratories for use in connection with problems or disputes arising among manufacturers. It is proposed, also, that this shop be utilized for the building of gages for manufacturers when the need is very urgent.

Manufacturers are urged to utilize the facilities of the Gage Section to the fullest extent in connection with their manufacturing work. In order that suitable arrangements can be made to handle promptly the routine work of gage testing, it is requested that the Bureau of Standards be advised now of the desire of manufacturers to submit gages for test and to utilize the other facilities available, and, also, that they notify the Bureau as to the approximate number of gages that they may wish to submit during the coming year.

United Engineering Society

Annual Report of President

During 1918 the activities of the United Engineering Society, the Library, the Engineering Foundation and Engineering Council were deeply affected by the German war and much important war work has been done in our building.

The endowment of Engineering Foundation was increased to \$300,000 by an additional gift of \$100,000 from Ambrose Swasey.

By bequest of Dr. James Douglas the American Institute of Mining Engineers received an endowment of \$100,000, the income of which will be expended in the maintenance of its library (now a part of the joint library).

The Library has continued to grow and improve and now contains over 153,000 books and pamphlets. The Library Service Bureau has gained steadily. Its business for 1918 amounted to nearly \$10,000.

Indexing of current engineering literature has been undertaken in conjunction with the Founder Societies and the Index is being printed in their publications. This service has been extended to the Engineering Institute of Canada and the Canadian Mining Institute. The expense is borne by the Societies. In this connection The American Society of Mechanical Engineers has purchased the Engineering Index heretofore published by *Industrial Management*.

In June the Westinghouse and General Electric companies donated to the United Engineering Society their Patent Control Library of about 8000 volumes. Other noteworthy gifts were a collection of 370 pieces relating to patent litigations, from Jesse M. Smith, and Dr. William Paul Gerhard's collection on gas engineering, transferred by the American Gas Association.

For lack of means the combined libraries of the Founder Societies have never been recatalogued as one library. The Library Board has just voted to undertake at once the complete recataloging of the Library. This work is estimated to cost from \$20,000 to \$25,000, and to require about two years. United Engineering Society can finance the project if the four Founder Societies are willing to contribute \$2500 each per year until the work is done.

War conditions continued to interfere with the receipt of foreign publications throughout the year. Details of the Library's work for the year are recorded in the annual report of the Library Board. [See Mechanical Engineering, February, 1919, p. 183.—Ed.]

The membership of Engineering Foundation Board was increased in April from eleven to sixteen and an executive committee of five members was provided.

The following matters have been considered by Engineering Foundation:

There has been continued coöperation with the National Research Council;

Information collected about industrial laboratories in this country;

Continued investigation of the wear of gears;

Investigation of spray camouflage for vessels;

Investigation of secret selective control of wireless communication;

Investigation of weirs for measurement of water.

The foundation offered to make a survey of existing engineering societies and to formulate recommendations regarding coöperation, but the suggestion was not accepted by the Founder Societies.

The annual report of the Foundation shows income for 1918 \$10,929.67, expenditure \$7,490.76, and accumulated unexpended income \$30,253.88. Its income is now \$15,000 a year.

On May 2 a dinner was given at the Engineers' Club to Dr. George E. Hale, Chairman, and other representatives of National Research Council, by the officers of the Founder Societies, and a large meeting was held in the Auditorium on May 28 at which an address was made by Dr. Hale.

A joint meeting of United Engineering Society and Engineering Foundation Board was held October 7 to receive Mr. Swasey's additional gift of \$100,000. This fund is in the form of securities and is deposited with the Cleveland Trust Company, of Cleveland, Ohio. November 14 a dinner was given to Mr. Swasey at the Engineers' Club, to which were invited the governing bodies of the four Founder Societies, the Engineering Foundation Board, the Library Board, Engineering Council and officers of the Club; seventy-two were present, including twenty-one presidents and past-presidents of the Founder Societies.

An oil portrait of Ambrose Swasey, painted by Weerts, of Paris, was presented by him to United Engineering Society and has been hung in the Library along with the portrait of Dr. James Douglas.

Engineering Council has devoted much of its energy to war work. The Council's work has been done through its general meetings, many committees and its secretary's office.

The committee called "American Engineering Service" was succeeded in November by Engineering Societies' Employment Bureau. It collected personal information about many thousands of engineers and filled many requisitions from various governmental departments, supplying the names of engineers carefully selected in each case. In addition, many engineers and vacant positions in civil life were brought together. The secretaries of the Founder Societies constitute the Board of Directors of this Employment Bureau.

The War Committee of Technical Societies devoted itself largely to reviewing thousands of inventions and suggestions for war work.

It was associated with the Naval Consulting Board. The Committee was discontinued in December.

Other committees appointed by Engineering Council have been the:

- Fuel Conservation Committee
- Public Affairs Committee
- Patents Committee
- Water Conservation Committee
- License Committee
- National Service Committee.

The Engineering Council has established an office in Washington, D. C.

Invitations have been extended to three additional societies to have membership and representation in Engineering Council.

The John Fritz Medal Board of Award, composed of representatives chosen by the Board of Directors of the four Founder Societies, awarded the medal for 1918 to J. Waldo Smith, "For achievement as engineer in providing the City of New York with a supply of water." The medal was presented before a large audience in the Auditorium on April 17.

The Engineering Societies Building has been fully occupied throughout the year. There are several applications for increased space, as well as applications from societies not now represented in the building. During the year the gratuitous use of the auditorium and meeting rooms was granted for various war purposes on twenty-two occasions. The taxes assessed upon portions of the building have been reimbursed by the six taxable societies. A change has been made in the superintendent, also the bookkeeper, resulting in economy and better efficiency.

The Society responded to the requests of the Fuel Administration for heatless Mondays and complied with the requests of the Board of Health of New York as to office hours during the influenza epidemic.

Four men who contributed largely of service or means to United Engineering Society have died since the last annual meeting: Dr. Frederick R. Hutton, Robert M. Dixon, Dr. James Douglas and Dr. Rossiter W. Raymond.

At this date the membership of the four Founder Societies is 36,000, and of associate societies 21,500, so that a total of 57,500 engineers now have headquarters in our building.

Funds for the benefit of Engineering Societies Library were obtained during 1918 from the following sources:

American Society of Civil Engineers	$4,000.00	
American Institute of Mining Engineers	4,000.00	
American Society of Mechanical Engineers	4,000.00	
American Institute of Electrical Engineers	4,000.00	
Income from Endowment Fund	5,000.00	
Total income		$21,000.00
Library expenses were as follows:		
Salaries (except Service Bureau)	$15,137.59	
Books and binding	3,905.90	
Supplies and miscellaneous expenses	1,682.27	
Total		20,725.76
Unexpended balance		$ 274.24
Funds for the work of Engineering Council were provided by contributions of $4,000 each from the Societies of Civil, Mining, Mechanical and Electrical Engineers—Total.		$16,000.00
Engineering Council's expenditures were:		
Secretary office	$6,368.85	
American Engineering Service and Employment Bureau	4,099.72	
National Service Committee	500.00	
War Committee of Technical Societies	2,257.68	
Traveling	363.54	
Total		13,589.79
Unexpended balance, December 31, 1918		$ 2,410.21
The income of the Society during 1918 was		$77,759.61
The expenditures totaled		72,342.28
Surplus for the year		$ 5,417.33
The surplus at the close of 1917 was		$ 8,116.10
The gain for 1918 has been		5,417.33
Total		$13,533.43
Amount now transferred to the Depreciation and Renewal Fund		8,000.00
Leaving the surplus December 31, 1918		$ 5,533.43

The General Reserve Fund established in 1915 remains at $10,000. The Depreciation and Renewal Fund is $86,163.78, the total of the two funds being $96,163.78.

The credits to the funds have been as follows:

	From General Funds	Interest
1907	$ 5,000.00	......
1908	5,000.00	......
1909	5,000.00	......
1910	5,000.00	......
1911	5,000.00	......
1912	5,000.00	......
1913	10,000.00	......
1914	20,000.00	1,441.39
1915	5,000.00	2,404.28
1916	10,000.00	2,610.45
1917	Nothing	3,581.29
1918	8,000.00	3,126.37
	$83,000.00	$13,163.78
	13,163.78	
	$96,163.78	

Beginning with 1915 the sum of $10,000 per year, plus interest earned, should have been added to the Depreciation and Renewal Fund in accordance with the action of the Trustees, November 19, 1914, or $40,000 for the four years of 1915, 1916, 1917 and 1918, but the income has not been sufficient and only $23,000 of the amount has thus been set aside.

The Funds held by the United Engineering Society December 31, 1918, were as follows:

Engineering Foundation Fund	$303,374.80
Library Endowment Fund	102,559.70
General Reserve Fund	10,000.00
Depreciation and Renewal Fund	86,163.78
Surplus	5,533.43
Total	$507,631.71

The real estate owned by United Engineering Society is valued at $1,947,171.16. The total net assets are $2,454,802.87.

The Finance Committee has very effectively supervised the accounts, the assessments, expenditures and the investments. Acknowledgements are also due the House Committee, composed of the secretaries of the Societies, for careful attention to the details of management of the building, and especially to Mr. Alfred D. Flinn, who has acceptably filled the post of joint secretary of the United Engineering Society, The Foundation and Engineering Council.

The affairs of the Society are believed to be in a satisfactory condition.

CHARLES F. RAND,
President, United Engineering Society.

FUEL PROBLEMS OF THE PACIFIC COAST

(Continued from page 269)

commercially practicable is compared with that of a high-grade compound locomotive working at maximum practicable steam pressures and superheat:

CENTRAL-STATION STEAM PLANT

Assumed steam pressure, lb. gage		300
Superheat, deg. fahr		250
Vacuum (30 in. bar.), in		28.5
Temperature of steam, deg. fahr		672
Total heat above 32 deg. fahr. B.t.u		1347.8
Available energy per lb. of steam, ft-lb		340,500
Heat efficiency, per cent		33.8
Efficiency of turbine including generator losses, per cent		78
Efficiency of boilers, per cent		75
Thermal efficiency of turbo-generator: $33.8 \times 0.78 \times 0.75 =$		19.8
B.t.u. per kw-hr. at generator $= \dfrac{3412}{0.198} =$		17,230
B.t.u. per kw-hr. at switchboard allowing 2.5 per cent for auxiliaries, etc.		17,660
Assumed load factor, per cent		50
B.t.u. per kw-hr. output of plant at 50 per cent load factor		21,200
Lb. coal of 11,500 B.t.u. per kw-hr. output of plant		1.84
Assume average percentage efficiencies of transmission and conversion from power house to drawbars of electric locomotive as follows:		
Step-up transformers	98.5	
Transmission line	95	
Step-down transformers	97.5	
Conversion apparatus	88	
Trolley distribution	90	
Locomotive	88	
Combined efficiency power house to locomotive drawbars	63.4	
B.t.u. per drawbar hp-hr. $= \dfrac{21,200}{0.634} \times 0.746 =$		25,000
Lb. coal of 11,500 B.t.u. per drawbar hp-hr. =		2.17

COMPOUND LOCOMOTIVE WITH SUPERHEATERS

Assumed steam pressure, lb. gage	225
Operating steam temperature, deg. fahr	625
Superheat, deg. fahr	227
Total heat above 32 deg. fahr., B.t.u	1326.6
Available energy per lb. of steam, ft-lb	184,500
Heat efficiency, per cent	18.5
Efficiency of engine (steam and mechanical), per cent	75
Efficiency of boilers, per cent	65
Efficiency from fuel to drawbar, per cent: $18.5 \times 0.75 \times 0.65 =$	9.02
B.t.u. per drawbar hp-hr. $= \dfrac{2550}{0.0902} =$	28,300
Assume load factor, per cent	25
B.t.u. per drawbar hp-hr. at 25 per cent load factor	46,000
Assume standby and other unavoidable abnormal losses, per cent	30
Total B.t.u. per drawbar hp-hr	65,700
Lb. coal of 11,500 B.t.u. per drawbar hp-hr	5.71

AMONG THE LOCAL SECTIONS

(The Usual Brief Accounts of the Sections' Meetings and Student Meetings Will Be Found in Section Two of MECHANICAL ENGINEERING.*)*

WE are just about in the middle of the active season for the Local Sections' work, and now is a good time to comment on how things are going and what are the prospects for accomplishing what we set out to do; what are the new tendencies and what will be the outcome at the end of the year.

Most of the Sections have now resumed their programs which were abruptly halted by the influenza epidemic, and some exceedingly interesting meetings are being held. For example, Cleveland carried out successfully on February 4 the first of its quarterly all-day conventions with the following program: 10:00 a. m., Rubber and Its Manufacture by Prof. H. E. Simmons, Akron; 11:00 a. m., Electric Traveling Crane Development (Illustrated) by G. W. Shem, Alliance Machine Co.; 12:30 p. m., luncheon served in C. E. S. rooms. Following this Colonel J. R. McQuigg gave an address on Some Experiences of Engineers in France. Automobiles were provided to take 250 guests and members to the new plant of the National Acme Company, which comprises over seven acres under one roof and an installation of the largest and most modern screw machines.

The party returned in time to arrive at the University Club where dinner was served at six o'clock. Dr. Charles S. Howe, President of Case School of Applied Science, was Toastmaster. Addresses were made by C. A. Otis of the War Industries Board and Major J. R. Campbell of the Ordnance Department on How the Big Guns Were Developed. Motion pictures taken at Aberdeen Proving Grounds were also exhibited. Over three hundred sat down to dinner.

Other meetings of unusual interest have been held at Boston and New York at which addresses were made by the representatives of the various societies who went abroad at the request of the engineers of France to confer on reconstruction problems. Accounts of these meetings are given elsewhere in this number.

Secretary Rice, at the time of writing, is on his second trip among the Sections and his experiences are being reported in another column. When he has completed this trip and also a third trip contemplated for the middle of March, he will have visited every Section as well as a number of places in which Sections are contemplated.

Mr. Ernest Hartford of the A.S.M.E. staff has been released by the War Department, and has now returned to his work in connection with Sections affairs. He has recently visited Cleveland, Akron, Erie, and Buffalo.

At the last meeting of the Meetings Committee a tentative program for the Spring Meeting was laid out and one of the professional sessions was assigned to the Mid-Western Sections for them to procure the papers; and the Chairman was instructed to visit Detroit and find out to what extent the suggestion could be put into effect. If it materializes that the Sections carry out this session, with the Detroit Section responsible for the entertainment of the whole convention, then the Sections will truly have played an important part in the Spring Meeting.

Coöperation with the Aims and Organization Committee should be pushed at this time. This Committee hopes to have a meeting about the end of March, and before long the Section delegates will take up with their respective Local Sections the matter of assigning a definite meeting to the discussion of this Committee's program. In the same connection, Local Committees should have received requests from delegates for the appointment of subcommittees in each Section to support these delegates; to date, about six Sections have made such appointments. This Committee's work is very urgent, as the field is enormous and the Committee has to make a report by the Spring Meeting.

Coöperation between the Increase in Membership Committee and the Local Sections has been initiated by the former Committee asking the Local Committees to what extent they have developed membership increase in their Sections. A number of helpful replies have been received and it is expected that the two major committees will shortly formulate a plan of coördination of activities.

An Unoccupied Rung in the Engineer's Ladder of Fame

DETROIT and the Detroit Section had the honor of being first to have an address from the new President of The American Society of Mechanical Engineers, Dean M. E. Cooley. President Cooley spoke at a special meeting of the Detroit Section held at the Board of Commerce on January 11.

He said that the Secretary at first asked him to make some informal remarks; but that later he had asked him to wire the title of his *address*. He had therefore spent a good part of one forenoon working up the title, and was so pleased with it that he wired it in immediately. But after he had sent the wire he had tried to think what he would say under the title. He told his audience that it was one of the finest titles he had ever worked out, and that some day he would write an address to go with it; but, nevertheless, the thought which he wished to bring to the meeting would work in with the title that he had decided upon, namely, An Unoccupied Rung in the Engineer's Ladder of Fame. Continuing, President Cooley said in part:

"It is unnecessary to point out to a body of engineers what engineers have accomplished in the development of the material part of the world's civilization. The entire world, so far as its material structure is concerned, can very justly be said to be the work of the engineer, or of professional men very closely allied to the engineer and to engineering. Our great buildings, our railways, the subways of New York City, would not be possible without the work of the engineer. But it is not necessary to enumerate such features. It is enough to say that it would be difficult to think of anything that makes it possible to live the life we are living—I am speaking, of course, of the material side—that was not conceived by the engineer.

"Then look at what has happened in our relations with different countries of the world through navigation on water and in the air, the latter developed to the most wonderful extent since the war began, and only in its infancy at the present moment. And look at the great conflict, with the result brought about by the work of the engineer—and the war itself brought about by the work of the engineer in the first place in helping to create commercial supremacy—fought and won by means designed and built by the engineer; and I think if the engineer had the settling of the war, it would be pretty well done; but it is going to be settled by other than engineers, and it won't stay settled, you can be sure of that. I don't want to speak in any pessimistic way at all, and I don't think I am so speaking when I say that it is in my bones that the war has just begun, absolutely just begun—that is a thought for you to carry away with you. Some of you will recall your study of history and the days of Augustus Cæsar, and following to the end of the decline of the Roman Empire, and at the beginning of the dark ages, when the Huns swept down and destroyed the civilization of the world. Who knows what the future has in store? Who can say that we are not going to have another dark age? I am not going to argue that we are at all—I just raise that question as something for you to think about. We are optimistic in this country. We are very optimistic with our opportunities in this country; we have no thought for the morrow except as we may make more than we made today.

"Now, all this leads around to the unoccupied rung I had in my mind.

"I have tried to show you that the engineer stands preëminent in the world today because of his work, upon which depends so much, the civilization in which we live, and because of which we have seen also the destruction in this war of civilization.

"Now, the engineer has done all these things in his professional capacity. We have wonderful experts. The different professions are filled with experts, men who know one thing and know it better than any other man in the world. It is natural that the engineer should become a specialist. It is the bread-and-butter thing for him to do. In doing this he is creating for himself a big reputation among his colleagues in engineering lines.

"But the engineering profession needs something more for itself, and the world needs something more from the engineer. The world needs the engineer with all his technical training to take a part in its general affairs, which up to now he has not taken. The engineer has not performed his duty to the general public. He has not given the general public the benefit of his knowledge which would enable many of the great questions which are puzzling the world today to be settled over night—if there was any desire to have them settled.

"Take your Detroit street-railway situation—you may not have heard of that. (Laughter.) It is as simple a problem as A, B, C; but does Detroit want it settled? What would be done for political capital if it were settled? *Quien sabe?* I am told that the same thing is true of Chicago. The engineer's job, as I see it in such a situation, is to make it known that problems like these can be settled if the people want them settled, and that the engineers know how to settle them.

"So the idea I had in mind in choosing this title that has been announced this evening, viz., this unoccupied rung in the engineer's ladder of fame, has to do with the engineer occupying positions in public relations which he has not up to now occupied.

"What is the best training for taking this position; going back to the college, for instance? I would say that the best training would be secured by first recasting the engineering curricula that we have. Leave out of them, at least, a quarter or half of the professional stuff that is now taught, and substitute for it the good old stuff that we used to have crammed down our throats when some of the older of us were boys or young men. I believe it to be a fact that the engineer who was graduated back in the 70's or 80's was a much more broadly educated man than the engineer who is graduated today. He was a better man to cope with the general problems that arose in the field of engineering, for the man graduated today can do only one thing, as a rule, while in those old days he could do a good many things well. While this may sound like heresy, I believe, nevertheless, that we should make our education more liberal. And if I can do one thing more before I finish my work at the University of Michigan, and one thing while I am president of The American Society of Mechanical Engineers, it will be to hammer on the one thought that we must break down the walls which we are building around the young men who are in college—walls built so high that they cannot look over. Break them down and use your influence to have them broken down. See that your boys, who are going to become engineers, are so trained that they do not have to remain privates or non-commissioned officers in an army of engineers but that they can be field officers, line officers, major-generals, lieutenant-generals of engineering, men who are qualified to be on the hilltop and look far away and have a proper perspective. That is what I mean by the unoccupied rung in the engineer's ladder of fame.

"Where do you find engineers occupying big public positions, political positions, if you like? But we do not like politics. How many engineers are there in Congress, how many in the cabinet? How many on the public-service commissions? Answer those questions and you will find where the unoccupied rung is. Perhaps we cannot do much in the little of life that is left to us, but certainly we can train those who follow us, and those who follow them. We should bring up in this country a different kind of engineer, a man who by his broad education and training will stand head and shoulders above the professional man of today. That is the kind of man I want to see, and you gentlemen can do it. My message to you tonight is to awake you to a sense of your responsibilities, not alone to your own profession but as an engineer and citizen to the public.

ENGINEERING RESEARCH

A Department Conducted by the Research Committee of the A. S. M. E.

Three communications have been received in time for this number of Mechanical Engineering which have been used in making up our notes for the current issue. Next month we hope to have many more. The success of the department depends on the coöperation of engineers who are engaged upon or are interested in research matters. Have you any data or inquiries to send in?

Information is desired relative to research work conducted by laboratories, either commercial or professional, by colleges, by Government institutions, or by individuals, and the Chairman would appreciate advice from any of these sources.

As outlined in the last number, the Research Committee hopes to conduct its department under the following heads:

A Research Results
B Research in Progress
C Research Problems
D Research Equipment
E Research, Personal Notes
F Bibliographies

The method of reporting work in these notes will be to give a title to research of a general nature followed by a serial number and the year. The special title will then be given. Reference by general title with numbers is all that is necessary. The name of the person is given from whom information may be had, together with the address.

Arthur M. Greene, Jr., *Chairman.*

B—Research in Progress

Metallurgy 2-19 Data on Influence of Size in Heat Treatment. (Research Committee of American Steel Treaters' Society.)

Metallurgy 3-19 Data on Critical Points. (Research Committee of American Steel Treaters' Society.)

Metallurgy 4-19 Statical Tests on Special Steels in Connection with Different Heat Treatments. (Research Committee of American Steel Treaters' Society.)

Metallurgy 5-19 Standard Heat Treatment of Gears, Shafting, etc., with Regard to Dimensions. (Research Committee of American Steel Treaters' Society.)

The above list represents the problems of a committee of a sister society and any data had by our members would be gladly received by their secretary, E. J. Janitzky, Metallurgical Engineer, Illinois Steel Co., So. Chicago, Ill.

Metallurgy 1-19 Bearing Metals. (Sub-Committee on Bearing Metals of the A.S.M.E., Christopher H. Bierbaum, *Chairman*, Buffalo, N. Y.)

Heat 1-19 Heat Transmission. Transmission of heat through various forms of partitions. (Sub-Committee on Heat Transmission, A.S.M.E. George A. Orrok, *Chairman*, 29 W. 39th St., New York.)

Lubrication 1-19 Lubrication. (Sub-Committee on Lubrication of the A.S.M.E. Albert Kingsbury, *Chairman*, Pittsburgh, Pa.)

Meters 1-19 Flow Meters for Fluids. (Sub-Committee on Flow Meters, A.S.M.E. R. J. S. Pigott, *Chairman*, 29 W. 39th St., New York.)

C—Research Problems

Gases 1-19 Critical Velocity for Gases. (Submitted by Strickland Kneass, Jr., Youngstown, Ohio.)

E—Research, Personal Notes

A visit to the Bureau of Standards at Washington, D. C., by the Chairman of the Research Committee of the A.S.M.E. was made on Feb. 10, 1919. The Director of the Bureau, Dr. S. W. Stratton, explained some of the work of the Bureau and made clear that the Bureau is prepared to give to manufacturers advice relating to fundamental facts and researches of physics, chemistry or any branch of science on which their special application may rest. This institution is organized to give aid to those requiring it if this aid is confined to the fundamental principles.

F—Bibliographies

Friction 1-16 Friction and Allied Subjects.

Research in Heat Transmission

At the recent annual meeting of the American Society of Heating and Ventilating Engineers George A. Orrok, Mem.Am.Soc.M.E., made a plea for coördination in research in heat transmission. Mr. Orrok is chairman of the sub-committee of the Research Committee of the A. S. M. E. on the subject of heat transmission, the other members of which are Prof. A. T. Wood, Dr. Harvey N. Davis, Dr. Edgar Buckingham and Arthur D. Pratt. Mr. Orrok said in the course of his remarks before the H. and V. Engineers:

The exigencies of the war have precluded the chance for any but the merest beginnings of the work of this sub-committee, as most of its members have been actively engaged in governmental activities. Mr. Buckingham is still in Italy; Mr. Pratt has had his hands full with work for the Emergency Fleet Corporation; Professor Wood with the S. A. T. C., and Dr. Davis and I with the helium work. However, we have found time to organize and partition the preliminary work among the various activities best fitted to secure results. Professor Wood has enlisted the committee of the American Society of Refrigerating Engineers in what I might call, in default of a better word, the "Insulation Division," and we have asked your committee of the American Society of Heating and Ventilating Engineers to work with them and coöperate along these lines and also in the subject of building materials.

Work on the radiator problem is being considered by your society as well as the A.S.M.E., and we shall be able to organize and coördinate this very shortly, as well as the kindred but very different line, that of aeroplane and automobile radiators. The problem of heat transfer under steam-generating conditions is also being organized and work is being done.

In the condenser and heater field there is yet some unpublished work which will be made public shortly and there are certain physical discoveries to be digested and applied to results already obtained. This work will be undertaken very soon and will be available.

In numerous other lines work has been laid out, and as fast as the men return from the front to their ordinary lines we shall endeavor to have work started and carried on to a satisfactory end.

But the main work of the committee, the formulation of an adequate and universal law of the transmission of heat, is, I think, very far off in the future. Dr. Buckingham, I believe, has stated that in the simple problem of the transfer of heat from steam to water through a copper tube there are 26 quantities entering into the equation, most of which are partially unknown or rather imperfectly known.

In this connection it is well to recall the many experimenters in this field who have worked on the same identical problem with results as diverse as can well be imagined. The fault lay in the apparatus used which had not been arranged with a view to the elimination of the many unknown factors affecting the transmission of heat. Some of these researches are of value today now that we know how to apply the proper correction factors, but most of them represent wasted effort. Another class of investigations are of little or no value because only such heat was transmitted as was present in the apparatus, the result being, of course, limited to this amount. Another class of experiments must be considered as useless since the leakage condition was so bad that no consistent results could be obtained. Let us report all contemplated and undertaken research to the committee, ask advice and avoid duplication.

Research Work and New Equipment at Purdue University

Tractor-Testing Laboratory. Through the agency of the Engineering Experiment Station at Purdue University, Lafayette, Ind., a new farm-tractor-testing plant is being constructed. The plan is to test farm tractors the same way as the locomotive has been tested at the same institution.

The equipment will be placed in a laboratory newly constructed for that purpose, and will include electric dynamometers, specially designed recording transmission dynamometers, and other apparatus. It is hoped by this means to assist in standardizing the information which the buying public, as well as the people who are in the market for the farm tractor, desire to know. A description, with photographs showing the complete plant, will be forthcoming for Mechanical Engineering in the weeks to follow.

Research Work. For a year and a half extensive work has been carried on at Purdue University along two distinct lines: One, under the direction of Professor Berry, in connection with the Engineering Experiment Station, takes up the carbonization of liquid fuels. Four phases of this research work are worth mentioning: The first is the volatilizing temperatures of liquid fuels as affected by a "hot spot"; second, the effect of efficiency on internal-combustion motors with the wet or dry mixture; third, the effect on efficiency and power capacity of preheating the air; and fourth, the effect on efficiency of raising the temperature of the mixture. A paper on some one of these phases will probably be prepared by Professor Berry for presentation at the Spring Meeting.

Another line of unusual interest being carried on at the University relates to the utilization of crushed coal in furnaces connected with power plants. In this connection the coal is not dried nor is the crushing carried to such an extent as to be in any way known as powdered fuel. Thirty per cent of the coal is about the size of a grain of wheat. Later on, when the results are completed, the whole story will be presented in a formal paper.

LIBERTY ENGINE TESTS

(Continued from page 253)

The mechanical adjustments when considered in connection with the motor inspection after test seemed to vary in proportion to the thoroughness of inspection between flights. Replacements which were made during the flight test all point to the same general kind of troubles in each case, and seem to be a true indication of the class of workmanship and inspection involved in the manufacture of these motors. It is quite probable, however, that many of the replacements made were not absolutely necessary for continual running, but they were considered essential for safety. (Bulletin, August 1918, p. 50.)

It may be added that the foregoing constitutes the first truly technical presentation of the achievement involved in the design and construction of the Liberty engine open to general engineering circles, and it is hoped it will help to dissipate the doubts and misunderstandings surrounding this subject. A general survey of these tests shows a careful and thorough effort to investigate all the elements contributing to the operation of the motor and a willingness to test the motor under strenuous conditions closely approaching those which it would meet at the front. Even though 160 hr. of continuous operation may not be sufficient to beat the average record of such an engine as the Rolls-Royce, it represents unquestionably a great achievement in view of the fact that the Liberty motor can be produced in quantity many scores of times greater than the Rolls-Royce could be produced under American conditions. Furthermore, for military use 125 to 160 hr. of useful life is fully adequate.

L. P. ALFORD
Member at Large

R. W. ANGUS
Ontario Section

E. S. CARMAN
Cleveland Section

R. COLLAMORE
Detroit Section

C. H. BIERBAUM
Buffalo Section

A. G. DUNCAN
Boston Section

S. B. ELY
Member at Large

J. T. FAIG
Cincinnati Section

H. P. FAIRFIELD
Worcester Section

H. GASSMAN
Birmingham Section

W. F. M. GOSS
Member at Large

COMMITTEE ON AIMS AND ORGANIZATION

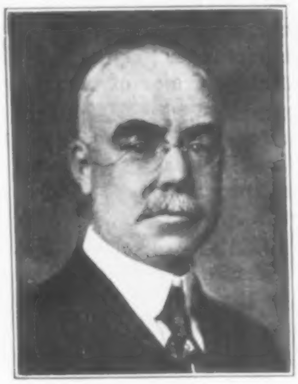
L. GUSTAFSON
St. Louis

J. HARTNESS
Member at Large

J. L. HENNING
New Orleans

The question of national coöperation among engineers and the improvement of their position in the esteem of society, a question of first importance in ordinary times, has assumed even greater moment in the period of reconstruction following the war, and serious attempts are being made by all the national engineering societies to reduce this coöperation to a concrete form. The participation of The American Society of Mechanical Engineers in this movement is being engineered by the Committee on Aims and Organization, appointed

D. S. Kimball
Member at Large



C. E. Lord
Chicago

F. R. Low
Member at Large

L. V. Ludy
Indianapolis

T. C. McBride
Philadelphia

L. C. Marburg
Member at Large

G. K. Parsons
New York

G. I. Rockwood
Member at Large

SECTIONS' DELEGATES AND MEMBERS AT LARGE

E. F. Scott
Atlanta

C. M. Spalding
Erie

L. E. Strothman
Milwaukee

last December to "discuss and formulate the aims of the Society in the light of modern development and present-day thought, and to assist toward finding a method of coöperation with the rest of the engineering profession suitable to carry out the aims." The committee consists of one delegate from each of the local sections and seven members at large. It held a two-day meeting in connection with the Annual Meeting and plans to report to the Society at the forthcoming Spring Meeting, to be held in Detroit, Mich., June 16 to 19, 1919.

C. W. Tubby
Minnesota

A. E. Walden
Baltimore

COMMITTEE ON AIMS AND ORGANIZATION

On pages 296 and 297 are given photographs of members of the new special Committee on Aims and Organization which held a two-days' session at the Annual Meeting, and which will meet again and prepare a report of progress to be presented at the business meeting of the Spring Meeting. The program of this Committee has already been published in MECHANICAL ENGINEERING, as well as the statement of its chairman of the results of its first sessions. The following supplement to the photographs will be of interest:

LEON P. ALFORD, member at large and member of the Executive Committee, is editor of *Industrial Management* and is an authority in that field. He is a graduate of Worcester Polytechnic Institute and has had many years' experience with machinery-building firms and in engineering editorial work. He is the author of several engineering publications. He has been active in committee work in the Society and was last year chairman of the Committee on Meetings.

CHRISTOPHER H. BIERBAUM, representing the Buffalo Section, has for twenty years made a special study of bearings, and in recent years has made extended researches on graphite and its application to lubrication. He is now doing special research work in the microstructure and microcharacteristics of the bearing alloys. He is chairman of the Sub-Committee on Bearing Metals of the Research Committee.

L. P. BRECKENRIDGE, representing the Connecticut Section, is best known for his work on fuels. He has been a teacher of mechanical engineering since 1882—at Lehigh University eight years, Michigan Agricultural College two years, University of Illinois sixteen years and Yale University five years. He has been very active in the work of the Connecticut Section.

E. S. CARMAN, representing the Cleveland Section, of which he is chairman of the Executive Committee, has been since 1913 secretary and chief engineer of the Osborn Manufacturing Company, Cleveland. He has been active in engineering society affairs for several years past; and especially active as librarian of the Cleveland Engineering Society, in advocating a united engineering organization for all branches of the profession.

RALPH COLLAMORE, representing the Detroit Section, has been continuously connected with the firm of Smith, Hinchman & Grylls since 1903. He has been president of the Detroit Engineering Society, the Michigan Chapter of the American Society of Heating and Ventilating Engineers, etc., and was chairman of the Organization Committee of the Detroit Section. He is a member of the Committee for Revising Building Codes of the City of Detroit, and was recently chairman of the Local Advisory Committee of the U. S. Fuel Administration.

ALBERT GREENE DUNCAN, representing the Boston Section, has been treasurer of the Harmony Mills, Cohoes, N. Y., since 1910. He has been active in society affairs and was at one time president of the National Association of Cotton Manufacturers. During the war he was appointed on the Boston Advisory Committee for the Purchase of Army Supplies.

SUMNER BOYER ELY, member at large, was at one time chief engineer of the American Sheet Steel Company, and secretary of the Board of Engineers of the U. S. Steel Corporation. He is a member and past officer of the Engineers' Society of Western Pennsylvania, and for the past year has been president of the University Extension Society of Pittsburgh.

JOHN T. FAIG, representing the Cincinnati Section, has been active in society affairs. He has been three times president of the Engineers' Club of Cincinnati, and is vice-president of the Society for the Promotion of Engineering Education. He was for twelve years professor of mechanical engineering at the University of Cincinnati, and since 1918 has been president of the Ohio Mechanics' Institute.

HOWARD P. FAIRFIELD, representing the Worcester Section, is secretary of the Sub-Committee of Machine Shop Practice of the Committee on Meetings. Since 1899 he has been on the faculty of the Worcester Polytechnic Institute, and in 1914 was appointed assistant professor of machine construction.

HOWARD M. GASSMAN, representing the Birmingham Section, was at one time chief electrical engineer of the Tennessee Coal, Iron and Railroad Company. Since 1916 he has been engaged in general consulting work along power and industrial lines, with offices in Birmingham.

W. F. M. GOSS, member at large, past-president of the Society, is president of the Railway Car Manufacturers' Association. He came to this position in 1916, after having been for eleven years dean of the College of Engineering at the University of Illinois.

LEWIS GUSTAFSON, representing the St. Louis Section, is chairman of this Section for the current session. He has been superintendent of The David Ranken Jr. School of Mechanical Trades, of St. Louis, since 1907, and prior to that for several years was with the Lewis Institute of Chicago.

JAMES HARTNESS, member at large, and past-president of the Society, is known as an inventor and manufacturer of various machines for metal turning, designed to take the place of the engine lathe. He has been granted over one hundred patents in this field. He is president of the Jones and Lamson Machine Company of Springfield, Vt.

JOHN LOVEJOY HENNING, representing the New Orleans Section, has been for twenty years with the Union Sulphur Company, operating the Frasch process for sulphur mining. He is now vice-president of this company and in charge of all their interests in the South.

DEXTER S. KIMBALL, member at large, is the chairman of the Committee on Meetings and Programs of the Society. He has been professor of machine design and construction at Cornell University since 1904, and during the summer of last year was acting president of the university. He is the author of publications on machine design.

C. E. LORD, representing the Chicago Section, is in charge of all patent and trademark work of all the International Harvester Companies. He is a member of the bar of the states of Ohio, Wisconsin and Illinois, as well as a member of a number of engineering organizations.

FRED R. LOW, member at large, has been editor of *Power* since 1888, in which position he has won distinction not only for the publication itself, but as an authority on power-plant subjects. He has served on a number of committees of the Society. He is the author of textbooks on steam engines.

LLEWELLYN V. LUDY, representing the Indianapolis Section, and member of the Executive Committee, has been professor of experimental engineering at Purdue University since 1912. Previous to that he was professor of steam and gas engineering at the University of Wisconsin.

THOMAS C. MCBRIDE, representing the Philadelphia Section, has been engineer for the Worthington Pump and Machinery Corporation since 1899. He is a specialist in sugar refineries, sugar machinery and paper mills and machinery. He was chairman of the Philadelphia Section when first organized.

LOUIS C. MARBURG, member at large, was elected as chairman of the Committee on December 3, 1918, after having acted as temporary chairman in accordance with resolutions of the executive committee of the general committee. He has been secretary and treasurer of Marburg Brothers, Inc., engineers, since 1910, engaged mainly in the import and export of engineering products. Previous to that he was with the Allis-Chalmers Company, General Electric Company, Sprague Electric Company, Siemens and Halske, and Sulzer Brothers.

GEORGE KINGDON PARSONS, representing the New York Section, is also chairman of the War Industries Readjustment Committee. For several years he has specialized in reorganizing and improving established businesses, as president of the G. K. Parsons Corporation.

EARL F. SCOTT, representing the Atlanta Section, has for the past five years been engaged in business as agent and contracting

mechanical engineer. He is now president of the corporation which bears his name, engaged in selling and installing power-plant equipment.

C. M. Spalding, representing the Erie Section, has been for more than twenty years with the General Electric Company, engaged chiefly in engineering and design of railway motors, railway locomotives, air compressors and other allied apparatus for railway service.

Louis Edward Strothman, representing the Milwaukee Section, entered the employ of the Allis-Chalmers Company in 1902 and has held various positions. In 1915 he became manager of the steam-turbine and pumping-engine departments. He was chairman of the Milwaukee Section in 1915 and was president of the Engineering Society of Milwaukee the following year.

Charles W. Turby, representing the Minnesota Section, has been in charge of the business of the Worthington Pump and Machinery Corporation since 1912 in the Middle Northwest and all of the Lake Superior mining regions. For six years previous to that he was in private business in St. Paul, representing builders of heavy machinery.

A. E. Walden, representing the Baltimore Section, has held responsible executive positions since 1891, including those of engineer in charge of construction, superintendent and manager of various companies, as well as construction and reconstruction of industrial and manufacturing plants, grain elevators, coal properties, transmission lines, etc.

John T. Whittlesey, representing the San Francisco Section, has since 1912 been retained to advise Messrs. Spreckels in their large public utilities interests in California. He was at one time chief engineer of the Brooklyn Rapid Transit Company, and also chief engineer of the Public Service Corporation of New Jersey.

Robert William Angus, representing the Ontario Section, was chairman of the Executive Committee of that Section last year. He has been professor of mechanical engineering on the faculty of applied science of the University of Toronto since 1906.

Charles H. Repath, representing the Los Angeles Section, was at one time mechanical superintendent of the Anaconda Copper Mining Company, and later superintendent of the International Smelting and Refining Company. He is now in consulting practice in Los Angeles.

George I. Rockwood, member at large, and member of the Executive Committee, is a consulting engineer at Worcester, Mass. He is president and treasurer of the Rockwood Sprinkler Company. He was formerly on the publication committee of the Society and was chairman of the Worcester Section.

NEWS OF THE ENGINEERING SOCIETIES

Inspiring Address by Dr. Ira N. Hollis before Engineering Institute of Canada—Heating and Ventilating Engineers Start Research Work—Automotive Engineers Meet

The Cleveland Engineering Society issues a live weekly Bulletin called "Cleveland Engineering" which bears out the reputation of the Society for maintaining close contact with both the public and its membership. The issue of this Bulletin of January 7 contains a portrait of Major Frank B. Gilbreth, Mem.Am.Soc.M.E., who gave a talk before the society, illustrated by moving picture films of the Browning machine gun. It also reprints in full from Mechanical Engineering (January, 1919, page 16) the article by Jesse M. Smith, Past-President, Am.Soc.M.E., on a plan for the organization of engineers.

Akron Engineers Form New Club

The engineers of Akron, Ohio, and vicinity met on the evening of February 5 for the purpose of organizing an association of engineers at Akron. Dean F. E. Ayer, head of the department of engineering of the University of Akron, was elected chairman; M. B. Robinson, professor of mechanical engineering at the University and a member of the A.S.M.E., was elected secretary and treasurer, and an executive committee of 14 members representing different lines of technical work was chosen. The following sub-committees have been appointed: Organization, Program, House and Publicity. The initiation fee has been set at \$5.00 and the dues at \$3.00, and one hundred and eight applications for membership have already been received.

Mr. E. S. Carman, Chairman of the Cleveland Section of the A.S.M.E., was present and outlined the successful work along both civic and engineering lines which has been accomplished by the Cleveland Engineering Society.

The second meeting of the organization was held Wednesday evening, February 19, with a dinner, followed by an address by the county surveyor relative to existing and proposed engineering operations in the county. These operations are vital in a large degree to the city of Akron, its water supply, etc.

American Steel Treaters' Society

There has recently been organized in Chicago the American Steel Treaters' Society, whose object is "to promote the arts and sciences connected with the heat treatment of steel." The principal means for this purpose are to be the holding of meetings for the reading and discussion of papers bearing upon processes, apparatus, instruments, etc., employed in research work and practice connected with the art of heat treating.

This Society is experiencing a rapid growth and a chapter with a large membership has already been formed in Cleveland, Ohio, while movements for chapters in other cities are under way. One of the aims of the Society is to reach into the heat-treating rooms of the various industries, and to further the worker's knowledge of the art by bringing him out to its meetings, where he will come into intimate contact with metallurgists, chemists and scientific men.

The society publishes a monthly journal which already contains a considerable amount of valuable material and undoubtedly will prove of increasing value. The Secretary, Mr. W. H. Eisenman, 154 E. Erie Street, Chicago, Ill., advises that many manufacturers have been quick to see the direct financial benefit to be derived by placing one or more of their staff in the society—one firm has 12. At a recent meeting in Chicago it was found that the interest in the subject was so great that several engineers came from distances of 80 and 100 miles to attend.

The Engineers' Club of St. Louis Alive to Municipal Affairs

In his letter this month Secretary Rice calls attention to the participation by the Engineers' Club of St. Louis in discussions relative to a municipal bond issue of that city, and in connection with this the following letter received from the secretary of the Engineers' Club of St. Louis will be of interest:

To the Editor:

Meetings of the Associated Engineering Societies of St. Louis were held on February 5 and 12 for the discussion of the proposed \$23,384,000 St. Louis municipal bond issue.

Topics of this kind are considered by the Engineers' Club of St. Louis and Associated Societies in conformity with a resolution adopting the principle of taking an active interest in economic, industrial and civic affairs.

Both of these meetings were a marked success in interest evi-

denced as well as in attendance. At the meeting of February 12 the attendance was double the average attendance.

As practically all of this proposed bond issue would be spent for municipal improvements directly involving engineering and the engineer, it is only natural that the engineer-citizen and the engineers as a body should give it due consideration.

The several items in the detailed budget of the proposed bond issue were presented to the meeting by engineers in the city employ who are in charge of the several departments of the public works concerned. In this manner the subject was placed intelligently before the members. The presentation of the subject took up the entire meeting of February 5. At the meeting of February 12 the discussion of the subject was continued and led by members of the Civic Committee of the Engineers' Club, which committee also had the matter under investigation for report. A very lively discussion developed at this meeting, and at the hour of adjournment was not nearly concluded; a resolution was therefore adopted requesting the Civic Committee of the Engineers' Club to report its recommendations at an early date relative to the issue to the Joint Council of the Associated Societies for further action.

Engineering subjects of public importance and matters affecting the engineer or the engineering profession are promptly considered by the Associated Engineering Societies of St. Louis in an endeavor to enlighten the public and to put on record an expression of the profession.

Joseph W. Peters,
Secretary.

American Society of Heating and Ventilating Engineers

The twenty-fifth annual meeting of the American Society of Heating and Ventilating Engineers was held at the Engineering Societies Building, New York, January 28-30, 1919, important features being the presentation of a number of valuable technical papers and the election of fifteen members chosen from among the different fields of activity of the society to constitute a Bureau of Research which will conduct experimental studies in coöperation with the Bureau of Mines. Funds are being collected to finance the work and the committee will undertake research work on the transmission of heat and similar engineering problems. The announcement of this commendable enterprise aroused considerable enthusiasm among the members and the opinion was generally expressed that the work will soon develop into a permanent activity for the good of the profession.

Dr. Emery R. Hayhurst presented the results of his experiments to determine the feasibility of maintaining in the ordinary house a proper humidity (40 to 50 per cent), comfortable temperature, and healthful atmosphere during the closed-up season of the year. His observations went to show that it requires up to 20 gal. of water per day (depending upon the temperature of the air to be heated and its rate of escape from the house) to supply sufficient water vapor for the air; he therefore recommended that some continuously operating device, such as an atomizer, be connected with the water supply of the building.

In a forceful discussion Dr. E. Vernon Hill pointed out the comparative values of mechanical and natural ventilation. The problem of ventilation, he remarked, is to determine what air conditions are desirable in a given space with a given type of occupancy, occupation, etc., and then to decide from experience and from tests in similar buildings whether these conditions can be maintained without mechanical ventilation; if they cannot, the mechanical adjuncts necessary to secure them will have to be adopted.

Air washing and humidification in school buildings was treated by Perry West, who emphasized the necessity for maintaining a constant degree of relative humidity in class rooms by quoting the New York State Commission on Ventilation. This body has conclusively proven, he asserted, that the enervating effect of 78 deg. as compared with 68 deg. for the air surrounding pupils reduces by at least 35 per cent their inclination to work. Mr. West explained that it is better to maintain the humidity at a convenient value than to raise the temperature alone to the point of comfort. Thus, for instance, on a zero day with 50 per cent humidity the air would have to be raised to 87 deg. to feel comfortable, and would then have a humidity of 2 per cent; if, however, by suitable humidification the air is maintained with a relative humidity of 50 per cent, the temperature would feel comfortable at 67 deg. and there would then be no enervating or devitalizing effect.

F. J. Hoxie called attention to the importance of properly arranging heating pipes to prevent decay of factory roofs. It appears from the records of his observations of the condition of various roofs that an effective protection of sawtooth roofs against decay is afforded by locating part of the steam pipes at the back of the sawtooth farthest from the windows. He illustrated his talk with several instances of roofs which had rotted in a few years in the part of the sawteeth where the heating pipes were placed directly under the windows and were well preserved where the pipes ran along at the bottom of the sawteeth.

Other papers were: The Transfer of Heat, by Geo. A. Orrok (referred to elsewhere in this number); Air Duct Design, by Leo Kraft; Dust Determination in Air and Gases, by E. R. Knowles; Fuel Conservation by Means of Automatic Temperature Regulation, by F. A. DeBoos; A Test of the Conductivity of Window Shades, by John R. Allen; Limiting the Fuel for Domestic Heating, by Konrad Meier; Engineering Economies of Heating, by M. W. Ehrlich; and By-Product Coke, by William T. Harms.

Society of Automotive Engineers

The annual meeting of the Society of Automotive Engineers was held in New York, February 4 to 6, 1919, at which papers were presented embracing a wide range of subject-matter. Mr. Chas. M. Manly was elected president for the coming year.

Among the papers dealing with war topics was one on Problems of the Naval Aircraft Factory During the War, by Commander F. G. Coburn, in which the splendid work done by the factory was described and the many expedients resorted to for improving the work shown. Airplane and Seaplane Engineering, again from the point of view of the work done by the Navy, was discussed by Commander H. C. Richardson, who showed, among other things, a chart for determining the efficiency of propellers and considered briefly the general matter of design of propellers, sea floats and seaplanes.

Two historical papers were also presented, one on The Story of the U. S. Standard Truck, by J. G. Utz, and another by J. G. Vincent, Mem.Am.Soc.M.E., on the designing of the Liberty engine, including certain data on its construction.

The Relation Between Airplane and Automobile Engines was discussed by several speakers. It was quite natural that such a subject should come up, as the greatest part of the work in designing aeroplane engines for the United States Government was carried on in automobile factories under the supervision of their own engineers.

Howard C. Marmon pointed out the essential factors controlling the design of areoplane and automobile engines and their differences. Thus, the automobile engine, besides being built for work under entirely different conditions both as to operation and maintenance, would not equal the aeroplane engine in power per cubic inch of piston displacement as it had to be carbureted for greater flexibility and not solely for maximum torque output through a comparatively limited range of speed. Neither could it use two or four carburetors like an aeroplane engine. An automobile engine could not use the high-compression pressure of an aeroplane engine as this would be impracticable at the full load, at low engine speeds and in climbing. Further, the lower-grade fuels commonly used in automobile engines gave more trouble under high compressions than the fuels customarily used in aeroplanes. Other points of difference in construction and design were considered; among other things being the fact that if an automobile engine were built with the same easy clearances on the pistons and the ample freedom given all the bearings it would make so much noise as to be entirely unsuitable for ordinary use. On the whole, the conclusion of the speaker was that the aeroplane engine was a more expertly engineered and manufactured development of the internal-combustion engine than the automobile engine. It was, however, developed for a set of objectives differing from those demanded in an automobile and none of its major features could be directly grafted upon the motor car. Further,

TABLE 1 AVAILABLE OIL REMAINING IN GROUND, AS ESTIMATED BY THE U. S. GEOLOGICAL SURVEY (BBL. OF 42 GAL.)

Oil fields	Marketed production in 1917	Marketed production in 1918 (preliminary estimate)	Total marketed production to end of 1918	Available oil left in ground, January 1919	Present average gasoline extraction, per cent
Appalachian	24,932,205	25,300,000	1,221,737,000	550,000,000	28.0
Lima, Indiana	3,670,293	3,100,000	448,404,000	40,000,000	20.0
Illinois	15,776,860	13,300,000	298,159,000	175,000,000	22.0
Mid-Continent	144,043,596	139,600,000	990,573,000	1,725,000,000	24.0
North Texas	10,900,646	15,600,000	78,971,000	400,000,000	33.0
North Louisiana	8,561,963	13,000,000	90,902,000	100,000,000	28.0
Gulf	24,342,879	21,700,000	303,954,000	750,000,000	1.5
Wyoming	8,978,680	12,370,000	39,793,000	400,000,000	40-50
California	93,877,549	101,300,000	1,114,000,000	2,250,000,000	12.0
Alaska, Colorado, Michigan, Montana, etc	230,930	230,000	10,651,000	350,000,000	....
Total	335,315,601	345,500,000	4,598,144,000	6,740,000,000	....

the speaker believed that motor cars would be improved as a result of aeroplane experience and that this would come about as a result of better manufacturing facilities, higher shop standards and more intelligent inspection rather than from any radical changes in design.

Essentially the same view was supported by the other speakers. Henry M. Crane said that he felt certain that there was no reason to expect any radical change in automobile design due to aircraft-engine development, though in racing cars the effect of aviation-engine progress was bound to be considerable, as the service required was very similar in both cases. In his opinion, the motor-car engine should be designed to develop its best pulling characteristics at considerably lower speed than does the aircraft engine, which will undoubtedly mean very much lower compression ratios and lower mean effective pressures.

O. E. Hunt gave further arguments to support the same contention. He pointed out that an aeroplane is almost entirely devoid of a power-transmission system. The conventional aeroplane engine has the propeller mounted directly on the end of the crankshaft. For certain purposes, reduction gears of a fixed ratio are used to drive from the crankshaft a lay shaft carrying the propeller, but gear changes, such as are applied to cars, are unknown. The only element of the power transmission that has a counterpart in car work is the propeller hub, which performs a similar function and is similar in design to the rear-wheel hub of cars. Aeroplane-propeller hubs must be readily demountable and this requirement has resulted in some new design details that are entirely unnecessary for cars.

The engine requirements for aeroplane service are so different from those for cars that factors which are vital in the former type of machine are of minor importance in the latter, and vice versa.

Like others, Mr. Hunt believed that the influence of aeroplane experience on automobile-engine design would be of an indirect nature—mainly in bringing about better methods of production and a higher regard for metallurgical practice.

An important section of the meeting was devoted to the consideration of the present fuel situation, in the course of which data of great interest were presented by various speakers.

E. W. Dean, of the U. S. Bureau of Mines, told of the status of refinery practice with regard to gasoline production. He said the refiner might be able to augment his production of gasoline from a given amount of crude petroleum by from 35 to 40 per cent, exclusive of the gains possible through wider application of the cracking reaction. Some of the possibilities, however, overlapped each other, and a more probable summation estimate was 25 to 30 per cent. The Bureau believed that, if commercial developments were favorable, the wider use of cracking processes might permit of further increases up to a possible additional 100 per cent. No prediction, however, was ventured as to what part of this figure would actually be attained.

It might be mentioned, also, that the development of engines capable of utilizing the combined gasoline and kerosene fractions of crude petroleum would not be likely to alter the limit of maximum increase, but would materially hasten the day when it would be attained, and would in considerable degree help to keep the price of liquid fuel from ascending to painfully high altitudes.

Mr. Dean's paper may have produced the impression that the Bureau of Mines is not enthusiastic over the advantages to be gained by the development of a kerosene-consuming internal-combustion engine. Such is not the case, but it must be emphasized that this is not the only line along which the automotive industry must work.

Jos. E. Pogue, of the Bureau of Oil Conservation, Oil Division, U. S. Fuel Administration, summed up the present engine-fuel situation by stating that the principal factors are the demand for liquid fuel and the adaptability of the internal-combustion engine on the one hand, and the supply of crude petroleum, the gasoline-producing capacity of this material, and the substitute fuels in sight, on the other. On the whole the speaker claimed the automotive industry is working without due regard to the engine-fuel situation, that the domestic production of crude petroleum is nearing its maximum, and that the natural-gasoline content of this fuel is lessening. Conditions in Mexico are such that no adequate relief may be expected from that source. Substitute fuels need not enter into present consideration and cracking cannot meet the issue at a favorable price. The burden, therefore, falls upon the automotive engine, which must consequently so adapt itself as to gain higher thermal efficiency, and to use less specialized (less volatile) fuel.

As an emergency measure, therefore, the automotive industry should at once take steps to shape its development in the direction of increased fuel economy and less specialized requirements as to fuel, establishing for this purpose centralized machinery to study the problem in full detail; should keep the industry informed of every development in the situation; should coördinate research and design in the competing units of the industry; and should conduct basic lines of research not now adequately encompassed by individual agencies.

The question of petroleum supplies in the United States and Mexico was covered respectively by Davis White, of the U. S. Geological Survey, and R. de Golyer, a consulting geologist of New York City, neither of whom gave very encouraging promises. Table 1, presented by Mr. White, is of particular interest as giving an authoritative estimate of the available oil remaining in the ground in this country.

While it is quite likely that the amount of fuel underground in Mexico is very great, there are both political and technical conditions which make it impossible to consider that country as a source of *speedy* relief for the existing situation.

Mexican petroleum is not refined as extensively as American, and the speaker stated that the greatest possibilities for future extended uses of Mexican petroleum seem to lie either in the further perfection and more widespread development of combustion engines using very heavy oils as fuel or in an improvement of refining methods by which heavy oils can be more easily converted into lighter oil.

Engineering Institute of Canada

THE annual meeting of The Engineering Institute of Canada, which was combined with a general professional meeting, was held in Ottawa, February 11, 12, and 13, and was one of the most successful ever held. The large attendance and the en-

thusiasm prevailing are evidences that there is a greatly increased interest being taken by Canadian engineers in their profession and show clearly that the recent changes in the organization were well justified.

The preliminary session of the Annual Meeting was held in Montreal, as prescribed by the by-laws, and was adjourned to Ottawa, February 11, with headquarters at the Chateau Laurier where all the meetings and luncheons were held. A notable feature of the gathering was the attendance of eminent engineers from the United States, all of whom gave addresses, including Dr. Comfort A. Adams, President of the American Institute of Electrical Engineers; Dr. Ira N. Hollis, Past-President of The American Society of Mechanical Engineers; Alfred D. Flinn, Secretary of the Engineering Council, and F. H. Shepherd, Director of Heavy Traction, Westinghouse Electric and Manufacturing Company. Other speakers outside of the membership of the institute were, The Duke of Devonshire, Hon. F. B. Carvell, Minister of Public Works, and The Hon. Arthur Meaghan, Minister of The Interior.

The first day's session, and part of the morning session of the second day, were devoted entirely to business, including a report of council, reports of library and house committee, finance committee; papers, board of examiners, and education, publications committee, international electrical technical committee, engineering standards committee, roads and pavements committee, and the reports of the branches. In Canada the branch societies of the Engineering Institute comprise the local engineering bodies, the membership including the members of the institute of all grades, who reside within 25 miles of the branch headquarters and branch affiliates. They conduct their own affairs, and elect their own members of council, and the reports show them all to be in an active flourishing condition.

The report of the Honor Roll Committee showed the great part that Canadian engineers have played in the war. The scrutineer's report, read by the secretary, announced the officers, with Lt.-Col. R. W. Leonard, M.E., as president.

A special meeting of the representatives of the various branches appointed to consider the subject of legislation placed a resolution before the meeting, which was adopted, to the end that a special committee be formed to meet at headquarters, before the 15th of April, 1919, to draw sample legislation, and that they submit the proposed legislation to the council before the 1st of May, following which a letter ballot will be issued to all the members and, if favorable, steps taken to secure legislation.

In his presidential address Mr. H. H. Vaughan, Mem.Am.Soc. M.E., told the story of munition production in Canada, which showed the remarkable proportion which it assumed.

The Gzowski medal, which is awarded every year for the premier Canadian paper on an engineering subject, was given to B. F. Haanel, M.E.I.C., for his paper on the Fuels of Canada.

Of the addresses given during the meeting of the Engineering Institute of Canada, we are fortunate in having the text of the remarks by Dr. Ira N. Hollis, Past-President, The American Society of Mechanical Engineers, given at a luncheon on February 12. Dr. Hollis was in his happiest mood and with clear vision and keen analysis spoke of the relations between Canada and the United States, and the part which each had played in the war. Dr. Hollis' address follows.

Address by Dr. Ira N. Hollis

A Broad View of the Aims and Opportunities of the Profession

I WANT to assure you that for a number of reasons it is a real delight to me to come to Canada, one of them being that I promised two or three times while I was President of The American Society of Mechanical Engineers to come to Ottawa, and every time I had to break my promise for some reason connected with our entering the war. This is, therefore, a redemption of my promise to friends in Ottawa and Toronto.

Another reason why I am glad to be here is that it affords an opportunity of congratulating you on the statement of the aims of your institute which appears on the cover of your journal. We as engineers often fail to understand the significance of our own profession. It is not necessary to shout from the housetops, but who has ever produced a better motto for an institute such as this than the following:

> To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession, and to enhance the usefulness of the profession to the public.

Numerous committees of The American Society of Mechanical Engineers, the American Society of Civil Engineers, and the Engineering Council have endeavored to state the aims and purposes of our societies, but with all our attempts in the past we have not produced anything as good as this.

I think that in The American Society of Mechanical Engineers the percentage of technical papers has decreased in proportion as the papers intended to be useful to the public have increased. I do not know whether that is the best thing for a technical society, but I do know that it bids fair to make our profession in the United States a profession of better citizenship. We must never forget that the purpose of any technical organization like ours or like this is mainly educational—to teach its members how to do their work better and how to serve the public and build up their relations with it in a better way.

Another reason for my coming here is deeper and broader than anything I could state in regard to our profession; it relates to your part in the war. Although much smaller in population than the United States, you, gentlemen, are our older brothers in arms. Upon your shoulders fell the first shock of the war as you rallied so splendidly to the defense of human liberty. I can state nothing better in this connection than two or three sentences contained in a letter from a relative on the other side who went in at Chateau-Thierry and ended up at Stenay. Every one of his letters contains some stronger statement of this sentiment. He said: "As the time goes on and I learn more about this war, I take my hat off to the British and Canadians who fought here in the beginning. We came in with our army as a large reserve, we fought in some important actions, and we were getting more troops to the front, but we came in at a time when the Germans were putting forth their last great effort after time for ample preparation, whereas the British and Canadians had to prepare while they were fighting. I take off my hat to them." I cannot help feeling, gentlemen, that that is the finest reason of all for my coming up here to salute you.

I look upon our race as the inheritors of the liberties of this world. After all, we have the English ideals of government on this continent, and we have to make all those who come to our shores from other countries English in ideals. South of the line we call ourselves Americans, and we call you Canadians, but we are all Americans in the freedom of the atmosphere in which we live. I come from that federation of states which split off from the mother country more than a century ago through a document written, after all, by Englishmen—one of the noblest statements in our language next to the Magna Charta. We are all Americans, and we have here on this continent the best league of peace that I can imagine. No fortifications on our boundaries, and war is unthinkable north of the Rio Grande. Our league is written in the hearts of two peoples who do not resort to bloodshed to settle their differences. As we meet here the Peace Conference is sitting in Paris and is working toward definite action—for what? It will be the most important decision ever made in the world, and it will be framed into some kind of statute where the cowardly bully who has bathed the soil of France in the blood of our sons and covered the ocean with ships and the bodies of the innocent is up for sentence to be rendered impotent until the centuries shall have turned him into a Christian.

So far as our profession is concerned, I am glad to bring the greetings of The American Society of Mechanical Engineers. We have the same warmth of feeling toward you that we have toward our members in the States, and we congratulate you on the formation of an Institute containing all the societies of engineers in the

youth of those societies. We have a harder task ahead of us in the United States to make one great society of engineers, because each separate society has already crystallized into its own methods and its own policies, thus rendering it difficult to form a union of all.

The Opportunities of the Profession

At the beginning of one of Mr. H. G. Wells' books you will find this sentence: "Civilization is advanced in proportion to a man's control over power outside of himself." Through what James Watt gave to mankind a little over a century ago we have entered our present era, the possibilities of which are not even thought of, inasmuch as we can use the power and energy that God placed on this earth for the development of man into something higher and far better than has gone before. Some day this century will seem but as the dark age to our descendants, and that mainly through the control of power entirely outside of man. I speak of this because that gives you plainly and at once the function and the place of the engineer.

I was speaking in New York not very long ago on the subject, Is Science Safe for Mankind? I dealt with the subject in all seriousness, for if science can be turned into a destructive agency to cover the earth with blood and to destroy all that has been previously produced, it is not safe. How can it be made safe? It can be made safe through our profession by approaching the discoveries and applications of science in that reverent attitude that will forever prevent its being used as a destructive agency. What does it amount to if we produce another railroad, another dock, a finer type of bridge, or a better machine, if it but leads to a conspiracy for the control of the earth? What does efficiency amount to if that, after all, is the end; if it places in the hands of the privileged few the control of the masses who are to be trained to service very much as the ox or the horse is trained?

The Engineer and Conservation

Another feature of the engineering profession is its opportunity to teach that proper attitude of mind toward the patrimony that nature has handed down to us on this continent so that we may prevent its being used or wasted in the destruction of mankind by self-indulgence or war. I can speak, perhaps, for the United States as I saw it before we entered the war. We were the most wasteful people on the face of the earth. We had found in our country immense resources which we prided ourselves on exploiting for the luxury and the greed of a great many people. But this war has brought to our profession a different vision, and we have certain things to think of. The first is found in the word "conservation," which has grown up in the United States, and which I have no doubt you have in Canada. What is the significance of it? It means the saving of everything that will help to perpetuate the influence of the Anglo-Saxon race; it means the saving of anything that will promote our ideals as a race; that our language and our efforts may civilize this whole world, the Germans as well as the others. I cannot help feeling that there are two or three aspects of that to which we have given but little attention. My interest in the matter was aroused in Massachusetts, because during the past eighteen months I have assisted in the conservation of fuel for that state. In Worcester, through an effective committee of manufacturers, where there are 200,000 people, during the past year we saved, not by cutting off any industries, but by actual scientific study of the problem of saving in our power stations and in our factories, 125,000 tons of coal —a million dollars saved for that city alone during the past year. In a state which takes 12,000,000 tons of bituminous coal in the course of a year, we saved at least ten per cent; and we were rash enough to promise Mr. Garfield and the Fuel Administration that we would take two and a half million tons less during this year than we took the previous year. We had just touched the fringe of this subject when the armistice was signed and the bottom dropped out of the whole movement. Are we going to permit this effort throughout the United States to break down? Not at all.

In my state—but it is not my state; I was born in Kentucky—when I went as a professor to Harvard College years ago, my picture was published in the Louisville *Courier-Journal;* and lest I should become vain on that account, my photograph was bracketed on the same page with a man who had been hanged in Louisville the day before. One of my friends saw that picture, an old farmer whom I had known in my youth, and who was living in Jefferson County, Kentucky. He said to me: "I see you have resigned from the Navy and are going to Harvard College as a professor." I said: "Yes." He said: "For God's sake don't do it; you are going amongst those d—— Yankees." The New England people do not like that story very much, but it shows that sometimes misunderstanding can exist among our states, the same as I have sometimes heard of between Canada and the United States. But whatever misunderstandings have occurred between those two countries, they do not approach some of the former bitterness between the North and the South; do not approach some of the misunderstandings between the different states. That man who was talking to me about New England knew nothing about the spirit which existed there, nor of the generous attitude of the people toward everything that has a value to the public. You will find in New England the same broad generosity to be found in Canada, if you look for it.

Returning to the subject of conservation, we have not only learned to save coal, but to save food; we have reduced the amount of transportation for unnecessary commodities and thus have made our railroads more effective. Saving can be effected in every respect, even in our water power. Indeed, there is nothing in which there is not room for further study and coöperation to the end that America—Canada and the United States—may remain as long as possible the chief influence for good on this earth.

Importance of Standardization

Next to conservation, standardization is the most important subject we have to deal with. There is an enormous amount of waste in the production of a great many articles which should be duplicates. There is not one aspect of manufacturing connected with engineering that is not susceptible of improvement by coöperation among manufacturers, to the end that articles for like purposes shall be produced in the same way and shall be standard. I think our economic supremacy among the nations is dependent upon this.

Engineers Must Equip for Administrative Work

Then there is the labor question. During the past six months we have been involved in the United States in the question of the relation between labor and the employer and in the reëmployment of soldiers. I do not know any men who are better qualified to take a hand in that than the engineers. But in this connection I want to destroy what may be called another illusion; a man is not competent to organize and direct industries or to handle labor questions simply because he is an engineer; he may only become competent by interesting himself in them if it is in his natural field. I have heard a great many people say: you ought to put engineers in the Administration. I say, not unless they fit themselves to go into the Administration. I have heard again that the engineer ought to take an active part in politics and in the public life of his country—not at all, unless he fits himself for it; and it is his business to fit himself. In other words, our profession is a great profession only in proportion as we make it so, and not by reason of the fact that we are called engineers.

Service in Peace as Important as Service in War

We talk about this having been an engineers' war, about machinery having won the war. But it is the blood of our sons which has won the war; it is the men who have done it. When I heard the statistics read by your president yesterday, I rejoiced that men in my profession, members of this Institute, could so help the world in this crisis. Of course, we were not in it so long; I sometimes think we were tardy in getting in. We got there, and we might have done a great deal more and suffered a great deal more if you fellows had not pretty nearly cleaned up

the thing before we got in to help. Nevertheless, we ought to keep in mind the fact that machinery alone did not win the war; what brings such a victory as ours is the willingness of men to give their lives for a great cause.

The same thing applies in time of peace; a man may help his country and the community by willingness to dedicate himself to a profession, to give himself to the advancement of the human race; and that willingness is expressed in the one word, " service." If I were to try to visualize the condition necessary to the progress of the world to-day, I would express it in two words, in the nature of a formula for our profession: " to serve." At the beginning of the war we heard very much the phrase " to make the world safe for democracy." After all that is but a method of saying that we are seeking a form of government for the human race that will permit every individual to develop the maximum of his possibilities in the service of mankind. That is what democracy means. Our profession will have great power in the near future of peace, in the league of nations, because no league of nations will last if the proper spirit is not there. Without that attitude of mind, we cannot achieve what should be our great purpose.

About two months ago it was proposed in New York that The American Society of Mechanical Engineers go to London for a meeting in a year or two. What I want to see within the next two years in London or Paris is a great meeting of all the engineers of this continent—civil, mechanical, electrical, mining—met together to rejoice over that peace that I hope is going to come out of the present proceedings in Paris.

NECROLOGY

ABRAM T. BALDWIN

Abram T. Baldwin was born on September 26, 1870, in Yonkers, N. Y., and was educated in the public schools and Cornell University, graduating from the latter with the class of 1893.

Upon graduation Mr. Baldwin first worked in the Wm. A. Sweet Rolling Mills, Syracuse, N. Y., and served his apprenticeship in practically every branch of the industry. In January 1895 he became connected with the Solvay Process Co., also in Syracuse, where he worked through the various departments, being assistant manager of the soda ash department at the time he left Syracuse to enter the coke department of the same company in Detroit. In May 1910 th Precision Instrument Co. was organized, in which Mr. Baldwin was very much interested. It was not until 1911, however, that he gave this company his full attention and at that time he became its treasurer; in 1913 he was made president and general manager of the firm, which position he was holding at the time of his death.

When the United States entered the war, Mr. Baldwin was asked to take up the manufacture of air-speed indicators for the Science and Research Division of the Bureau of Aircraft. His work in this connection was so arduous that it resulted in his physical breakdown and sudden death from heart collapse on January 8 in Boston.

Mr. Baldwin was greatly interested in the combustion of coal and efficiency of boiler operation. He was a member of the Detroit Engineering Society, the National Association of Stationary Engineers, the American Gas Institute and the Detroit Board of Commerce. He became a junior member of the Society in 1899 and in 1902 a life member.

CHARLES C. CHRISTENSEN

Charles C. Christensen was born on September 30, 1851, in Copenhagen, Denmark. He attended the technical college at Navy Yard. Horten, Norway, where he studied marine and mechanical engineering. He served an apprenticeship in shop practice and drafting from 1871 to 1875 in Norway. The next four years he worked with the firm of Jansen & Dahl, Norway, as a designer on iron vessels and on engines.

In 1880 Mr. Christensen came to the United States, where he was employed by the Allis-Chalmers Co. as draftsman. From 1882 to 1888 his position was that of designer of mining machinery and at the end of that period he was placed in charge of the engineering and drafting department. From 1889 until the time of his death. December 13, 1918, he held the position of estimating engineer.

Mr. Christensen was the author of a number of articles relating to mining machinery which have been published in both American and English mining journals and also translated for Spanish and German technical periodicals. He became a member of the Society in 1890.

MICHAEL JOSEPH GOLDEN

Michael J. Golden was born on November 17, 1862, in Stratford, Ont., Canada. He received his early education in the schools of Lawrence, Mass., and later attended the Massachusetts Institute of Technology for two years as a special student. He served an apprenticeship with William McCartney in Lawrence and was for six years assistant to E. Lyford.

For one year he was an instructor in mechanical drawing at a high school in Hyde Park, Mass. In 1884 he became connected with Purdue University, Lafayette, Ind., as an instructor in shop work, later receiving his degree in mechanical engineering from the University. From 1889 until June 1916, when ill health compelled his resignation, he served as professor of practical mechanics at Purdue, and from 1907 was also director of the practical mechanics laboratory. He was considered an authority in shop management and shop experience and his course of shop lectures was widely known. He spent much of his time in research, investigating microscopically the structure of wood, for this purpose designing and building much special apparatus.

Professor Golden was the author of several works on mechanics and of a number of shorter articles which appeared in the technical press. He was a member of the Indiana Academy of Science, the American Society of Naval Engineers and the Manual Training Teachers' Association of America. He became a member of the Society in 1892. His death occurred on December 18, 1918.

LAURENCE RICHARD GULLEY

Laurence R. Gulley was born at Mason, Mich., on August 14, 1888. He attended the University of Illinois, receiving in 1910 his B.S. degree in mechanical engineering (M.S. in 1911; M.E. in 1917). From 1908 to 1911, during his vacations, he was connected with the Burr Co., Champaign, Ill., as draftsman.

Upon graduation he was employed by the same company and from 1911 to 1913 he served as chief engineer. In 1913 he became general manager of the firm and at the time of his death, October 24, 1918, in addition to holding this position, was also secretary of the Burr Co.

A short while previous to his death Mr. Gulley had designed and built the Gulley tractor dynamometer, which has proved of much interest to tractor-manufacturing concerns.

Mr. Gulley was a member of the honorary societies of Tau Beta Pi and Eta Kappa Nu. He became an associate-member of the Society in 1917.

GEORGE SHERWOOD HODGINS

George S. Hodgins, editor of *Railway and Locomotive Engineering*, died at his home in New York City on January 18, 1919. He was born in 1859 in Toronto, Ont., and was a graduate of the Upper Canada College and the school of practical science. University of Toronto.

He served his apprenticeship with the Canadian Locomotive & Engine Co., Kingston, Ont., in machine-shop work, locomotive erecting, etc. In 1882 he was appointed draftsman in the same company and was directly responsible for locomotive design. After some experience in a division master mechanic's office on the Canadian Pacific Railway, he was advanced to various positions on the road and of late was locomotive inspector on the entire system. In 1889 he was recalled to the Canadian Locomotive Works as mechanical engineer, where he had charge of all engineering and designing work. Later he entered the service of the Pressed Steel Car Co., Pittsburgh, Pa., as general inspector of the output of that extensive plant, and was also for some years inspector of the Richmond Locomotive Works.

During these earlier years he had contributed to a number of railroad publications. In 1900 he entered the field of practical journalism as editor of *The Railroad Digest*. In 1902 he joined the staff of *Railway and Locomotive Engineering* as associate editor and in 1908 became managing editor, which position he held until 1911, when he was called by the Canadian Government to make a comprehensive report on the shops, appliances, tools and equipment necessary for the Trans-Continental Railroad. On the completion of that work in 1915 Mr. Hodgins joined the staff of the Railway Periodicals Company as managing editor of the *Railway Master Mechanic* and *The Railway Engineering and Maintenance of Way*. In 1916 he returned to *Railway and Locomotive Engineering* and remained on the staff as editor until his death.

He contributed many articles to popular science magazines and as a writer on engineering and technical subjects his style was marked by an exact and comprehensive lucidity.

Mr. Hodgins became a member of the Society in 1908.

HENRY SMYTH ISHAM

Henry S. Isham was born in New Britain, Conn., on March 16, 1866, and was educated at Mowry and Goff's English and Classical School, and at the Bryan and Stratton Business College in Providence, R. I.

He first served an apprenticeship of three years with the Harris-Corliss Engine Works, Providence, and then entered the service of

the Rhode Island Locomotive Works in the capacity of draftsman. From that position he went as draftsman with the Jeffrey Manufacturing Co., Columbus, Ohio, and in the following year, 1892, he became connected in the same capacity with the Johnson Steel Co., Johnstown, Pa. Mr. Isham's next position was with the Pond Machine Tool Co., Plainfield, N. J., as draftsman. The year of 1895-1896 he was with the Washington, Alexandria and Mount Vernon Railway, and a little later was located in the chief engineer's office of the Central Railroad of New Jersey. For over a year he worked with the Mossberg Manufacturing Co., Attleboro, Mass., leaving that firm to take a position in 1897 with the Metropolitan Street Railway Co., New York City, as track expert in the office of the engineer of maintenance of way. From 1899 to 1901 he was designing draftsman for the São Paulo Railway, Light & Power Co., Ltd., São Paulo, Brazil, S. A.

In 1901 Mr. Isham returned to the United States to enter the employ of the Pennsylvania Steel Co., Harrisburg, Pa., remaining there until 1903. From 1903 to 1908 he was chief draftsman with Ford, Bacon & Davis, New York City, and then became associated with the New York Railways Co., where he had charge chiefly of the track work. His next connection was again with Ford, Bacon & Davis as chief draftsman. About the middle of 1918 he entered the service of the New York Edison Co., New York City, and was with that company at the time of his death, which occurred in an accident on November 28, 1918.

Mr. Isham became a member of the Society in 1902.

PAUL JONES

Paul Jones was born in Wilmington, Del., on May 11, 1881, and was educated in the schools of that city, later attending the Heath School. He studied as a special student in mechanical and mining engineering and in 1902 took a position with the Diamond Steel Co., Wilmington, where he was engaged in general drafting for iron- and steel-works equipment, later becoming engineer of tests and then assistant to the superintendent of shops and steel products.

In 1906 Mr. Jones became connected with the E. I. du Pont de Nemours Co., Wilmington, in the light, power and heat division. His duties were in the general office and in field engineering work in connection with construction, design and maintenance of power plants and power transmission systems and costs. His next position was in 1909 with the H. C. Frick Co., United States Steel Corporation, Pittsburgh, Pa., as assistant engineer for the design of coal and coke plants, railroad trackage and structures, power plants, etc. For the year 1910 to 1911 Mr. Jones's services were loaned to the G. S. Baton Co., as construction engineer, where his duties were along the same lines as they had been with the Frick Co. He returned to the employ of the Frick Co. and was made plant superintendent of the Filbert Works. He completed this plant, developing and maintaining all plant operations.

In 1914 he became associated with the Bosch Magneto Co., Plainfield, N. J., as works engineer. He was engaged in the design, construction and maintenance of buildings and equipment and the direction of power-plant systems. In the Spring of 1918 he was commissioned a first lieutenant in the Aviation Section, Signal Reserve Corps, of the Army and was assigned to duty in the finance department. At the time of his death, December 17, 1918, he was connected with the Air Nitrates Corporation, New York, having been honorably discharged from the service.

Mr. Jones was a member of the American Institute of Mining Engineers. He became an associate-member of our Society in 1917.

GEORGE ALEXANDER JUST

George A. Just was born in 1860 in New York City. He attended Rensselaer Polytechnic Institute, from which he was graduated in 1881 with the degree of C.E. He was first employed by the Phoenix Iron Works, and then was connected with the New Jersey Steel and Iron Co., Trenton, N. J., later acting as engineer for that firm in New York. He was also chief engineer of the Jackson Architectural Iron Works, afterward becoming a member of the firm Lewison & Just, consulting engineers.

Mr. Just was a pioneer in the steel industry and was at one time associated with Cooper, Hewitt & Co., and was one of the first engineers to develop the modern steel-frame building. At the time of his death, December 27, 1918, he was president of the George A. Just Co. He took an active interest in politics and was the engineer member of the commission which framed the Code of Building Laws for Greater New York, and from 1907 to 1915 served as chairman of the Board of Examiners of New York.

He was a member and ex-director of the American Society of Civil Engineers. He became a member of our Society in 1904.

DAVID TOWNSEND

David Townsend, a member of the Society since 1882, and vice-president during the years 1899 to 1901, died at his home in Philadelphia, Pa., on November 27, 1918.

Mr. Townsend was born on February 21, 1856, in Philadelphia, Pa. He was a graduate, class of '76, of the University of Pennsylvania, degree of B.S. In 1878 he was a special student at Stevens Institute of Technology, and assistant to Dr. R. H. Thurston and Prof. Albert H. Leeds. From 1878 to 1893 he was with the Bush Hill Iron Works, Philadelphia, specializing in rolls, rolling mills, steel and iron works construction equipment. He first served his apprenticeship in machine shop, foundry and drawing room, later becoming general manager. In 1893 he became general manager of the Philadelphia Roll & Machine Co., building and operating their works. He was with this firm until 1898, when he went to Germany to the Krupp Works at Magdeburg to study the methods and construction of the Gruson Revolving Coast Defense Turrets. Upon his return he designed, built and operated the Gruson Iron Works, Eddystone, Pa., as general manager. In 1903 this property was sold to the Baldwin Locomotive Works, who have since occupied it for themselves and for the Remington Arms Co.

From 1903 to 1912 Mr. Townsend was engaged in private engineering practice, specializing in iron and steel foundries, roll and rolling-mill designs and general construction for iron and steel products. Mr. Townsend became president of the Production Engineering Co. in Philadelphia in 1912, specializing in oil-burning apparatus of all kinds, holding this position up to the time of his death.

During the year 1916 he was also manager of the Philadelphia plant of the Neidich Process Co. and the Calco Chemical Co., producing aniline dyes.

AUGUST H. BORNHORST

Lieut. August H. Bornhorst was born on August 1, 1888, in St. Marys, Ohio. He received his early education in the schools of St. Marys and then attended Ohio State University, from which he was graduated in 1911 with the degree of M.E.

August H. Bornhorst

He first worked with the Ford Motor Co., Detroit, Mich., as machine designer on a 5000-hp. gas engine. In March 1912 he was assigned through a civil-service appointment to the U. S. Engineer's Office, Seattle, Wash., as mechanical draftsman, where he designed cranes for handling concrete work and designed and laid out lock gates, lock-gate machinery and a proposed emergency dam. In March 1916 he became connected with the Puget Sound Navy Yard, Bremerton, Wash., as a marine-boiler and engine draftsman. Later he was connected for a short period with the Seattle Machine Works.

In July 1917 he entered the service as a first lieutenant in the Signal Officers' Reserve Corps and was afterward transferred to the Aircraft Production, Air Service Branch of the Army, in which he was serving at the time of his death, December 7, 1918.

Lieutenant Bornhorst became a junior member of the Society in 1916.

JOHN HORTON DALLY

John H. Dally was born on July 10, 1868, in Lafayette, N. J. He was educated in the public schools of Newark and later attended the Newark Technical School, of which he was a graduate. He served a three-years' apprenticeship with the Watts-Campbell Co., Newark, and from 1891 to 1895 worked in the shops of the same concern. He spent one year with the Richmond Locomotive Works and for the Whitehall Engineering Co. He was also connected for short periods with the Colorado Automatic Refrigerating Co. and with the New York Refrigerating & Construction Co. He was chief engineer of the Waldorf-Astoria Hotel, New York, for about a year and a half, and from 1896 to 1902 was chief engineer of the Carnegie Music Hall, New York.

From 1903 until the time of his death, December 23, 1918, he was chief engineer of the New York Stock Exchange. Since 1897 he had also acted as supervising engineer for the Fine Arts Society.

Mr. Dally became a member of the Society in 1903.

J. SELLERS BANCROFT

J. Sellers Bancroft, general manager and mechanical engineer of the Lanston Monotype Machine Company, of Philadelphia, Pa., died in that city on January 29, 1919.

Mr. Bancroft was born in Providence, R. I., in 1843. He became a member of the Society in 1880, and held the office of manager from 1909 to 1911, and that of vice-president from 1915 to 1917. A more extended notice will appear in the April issue.

PERSONALS

In these columns are inserted items concerning members of the Society and their professional activities. Members are always interested in the doings of their fellow-members, and the Society welcomes notes from members and concerning members for insertion in this section. All communications of personal notes should be addressed to the Secretary, and items should be received by March 15 in order to appear in the April issue.

CHANGES OF POSITION

J. Paul Clayton has resigned his position of commercial manager of the Middle West Utilities Company, Chicago, Ill., and has been elected vice-president of the Central Illinois Public Service Company, Mattoon, Ill.

Frank H. Abbey, for the past six years Boston manager for the Gifford-Wood Company, has been elected president of the Southworth Machine Company, of Portland, Me. The new duties, assumed on January 1, 1919, include the general management of the company.

Lemuel C. Biglow, who for a number of years acted as New York manager for the Morse Chain Company, of Ithaca, N. Y., and who for the past year has been connected with the Charles A. Schieren Company, as manager of their engineering department, has been appointed eastern representative of the W. A. Jones Foundry and Machine Company, of Chicago, Ill., with headquarters in New York City.

Malcolm M. Henderson has resigned his position as chief mechanical engineer of the Commonwealth Railways of Australia and has joined the Perry Engineering Company of Adelaide and Gawler, South Australia, as manager.

Manning E. Rupp has severed his connection as superintendent of the ordnance department, Curtis and Company Manufacturing Company, St. Louis, Mo., to become associated with the Gifford-Wood Company, Hudson, N. Y., as general superintendent.

Lewis S. Maxfield has resigned his position as mechanical engineer with the Carver and Nate Company, engineering contractors, to accept the position of assistant to the secretary of the Heating and Piping Contractors' National Association, New York.

William F. Parish, for many years manager of the lubricating division of the Texas Company, and lately chief of the oil and lubrication branch, Air Service, War Department, has joined forces with the Sinclair Refining Company, Chicago, Ill. As technical director of the company, Mr. Parish will assist in organizing the section of lubrication engineering, and in connection with the lubricating sales department will aid in establishing broader and more direct representation.

Fred W. Fischer has severed his connection with the United States Nitrate Plant at Muscle Shoals, Ala., to accept the position of boiler-plant supervisor with the Du Pont Engineering Company.

Theodore H. Hermanson, formerly with the Harrison Works of the Worthington Machinery Corporation, has become associated with the Epping-Carpenter Pump Company, of Pittsburgh, Pa., as works manager.

Edmund S. Higgins, until recently affiliated with the Du Pont Engineering Company, Richmond, Va., has accepted a position with the Oakland Motor Company, Pontiac, Mich.

F. L. Gilman resigned his position as works manager of the National Conduit and Cable Company last November, and has left for abroad to take a position as European general superintendent for the Western Electric Company, in charge of the company's manufacturing plants in England and on the continent.

Alexander A. Koswick, formerly with Wright-Martin Aircraft Corporation at their Long Island plant, has accepted a position as an engineer with Ford, Bacon and Davis, in their valuation and report department, with headquarters in New York City.

ANNOUNCEMENTS

Captain Julius M. Lonn, who for the past 20 months has been located in the small-arms ammunition department at the Frankford Arsenal, Philadelphia, Pa., has been released from military service and has resumed his position in charge of engineering with the Great Western Manufacturing Company, La Porte, Ind.

G. Charter Harrison announces that Eric A. Camman, associated with him since the establishment of the business, has been admitted into partnership. The firm will continue to specialize in the design of plans to meet modern industrial problems, under the firm name of G. Charter Harrison and Company, with offices, as heretofore, in New York City.

George H. Sharpe, until recently fuel engineer for the conservation department, United States Fuel Administration, has become associated with Frame, Friend and Stineman, Inc., New Haven, Conn., as consulting fuel engineer.

E. Logan Hill, secretary of the United States Shipping Board Commission on Port and Harbor Facilities, has resigned and has become associated with Heyl and Patterson, Inc., contracting engineers of Pittsburgh, Pa. Previous to his appointment as an official of the Shipping Board, Mr. Hill was assistant general manager of the Erie Railroad. He will be located at the New York sales office of the company, which is particularly interested in the application of their cranes to wharves, cargo handling and other special purposes.

Theodore Maynz has become associated with the Gulf Pipe Line Company, Houston, Tex.

Lieut. E. R. Glenn, who has been acting as production officer for the ordnance department at the Bethlehem Steel Company for the past year, has been discharged from the service and has become associated with the Simplex Valve and Meter Company of Philadelphia, Pa.

Cleon E. Phelps, recently discharged from Government service, has accepted the position of assistant works manager of the Underwood Computing Machine Company, Hartford, Conn.

Major James Guthrie, Ordnance Department, U.S.A., has been ordered from Washington to Detroit, becoming engineering manager for the Michigan district, with headquarters at 818-820 Book Building.

E. Howard Reed, vice-president of Reed and Prince Manufacturing Company, Worcester, Mass., is in the naval service and has been transferred from the torpedo station at Newport, R. I., to duty at Toledo, Ohio.

Major R. W. Fuller, Ordnance Department, Washington, D. C., is leaving for Japan, China and Vladivostok, Russia, where he will represent W. R. Grace and Company of New York City.

Paul P. Bird has assumed the presidency of the Boston Sand and Gravel Company, with headquarters in Boston, Mass. He retains his partnership in the engineering firm of Norton, Bird and Whitman, of Chicago and Baltimore, and has opened an office for the firm in Boston.

L. H. Thullen was elected president of the Grand Rapids Brass Company, Grand Rapids, Mich.

William McCormick Neale, formerly connected with the Newman Machine Company, Greensboro, N. C., as secretary, treasurer and mechanical engineer, announces the opening of an office in Greensboro for consulting practice, specializing in plant design, and the design and development of special labor saving machinery and devices.

W. S. Quigley, president of the Quigley Furnace Specialties Company, Inc., sailed for Liverpool on the Baltic, February 15, for the purpose of further developing European connections of his company. Mr. Quigley will spend several weeks in England, France and Italy and visit the plants installing the Quigley system for preparing and burning pulverized coal and lignite.

APPOINTMENTS

Captain Edward E. Ashley, Jr., for many years consulting mechanical and electrical engineer for Starrett and Van Vleck, architects, of New York, has resigned his commission in the Air Service of the U.S. Army to accept an appointment as sales engineer of the Mercury Manufacturing Company, Chicago, Ill. This company manufactures electrically driven tractors for use in connection with industrial haulage systems.

Charles W. Stephen has been appointed assistant works manager of Pratt and Cady Company, Hartford, Conn. He retains his present position as mechanical engineer.

Max E. Cuttler, formerly supervising engineer and superintendent of the Hamilton and DeLoss Company, Bridgeport, Conn., has been appointed general superintendent of The Hawthorne Company, which was merged with the Hamilton and DeLoss Company on February 1.

AUTHORS

S. H. Graf has contributed an article on Structure and Strength of Overheated Rivet Steel to the February 6 issue of *Engineering News-Record*.

H. Cole Estep addressed the members of the Cleveland Engineering Society at a luncheon on January 31, on reconstruction work upon which engineers will be called. Mr. Estep was a member of a mission of fifteen technical experts invited by the British Government to inspect British industries and the western front.

Dr. Richard Moldenke was the speaker at the New England Foundrymen's Association meeting, February 12. The subject of his address was Foundry Melting Methods.

LIBRARY NOTES AND BOOK REVIEWS

Our Cities Awake

Our Cities Awake. Notes on Municipal Activities and Administration. By Morris Llewellyn Cooke, M.E., Consulting Engineer, formerly Director of Public Works, City of Philadelphia. With Foreword by Newton D. Baker, Secretary of War. Doubleday, Page & Co., Garden City and New York, 1918. Cloth, 5 x 7½ in., 351 pp., 119 illustrations. $2.50.

Morris Llewellyn Cooke was a pupil and discipline of Frederick W. Taylor. Efficiency means more to him than a time clock and a card index. He was among the first to emphasize the part that the engineer should play, not only in industry, but in public life. When, therefore, he was called by Mayor Rudolph Blankenburg as Director of Public Works of the City of Philadelphia in 1912 he brought to the task the vision of a city in which not only the things that must be done should be done in the most efficient and creditable way, but in which the application of the common means and effort of a people with an awakened civil consciousness to the making of their city rich, artistic and beautiful, and their communal life helpful, inspiring and enjoyable, should be developed to the utmost. The book is a commentary upon his experience in the office, interspersed with observations suggested by that experience and his study of public management, or drawn from the experiences of other cities; with the views of other publicists, and information, statistical and otherwise, from various sources.

The first chapter, Paving the Way, tells how the interest of the people was aroused, and discusses financial methods, budgets, cost-keeping and appropriations. The abuses attending the jockeying of contracts are described, and the public manner adopted for opening bids illustrated. Ten pages are devoted to an exposé and condemnation of the common practice of levying assessments upon city employees by political parties.

Chapter II considers Some Mechanisms of Municipal Management such as Home Rule for Cities, Municipal Government by Commission, The City Manager, The Ballot (favoring the short variety), Functional Management, Committee Control and Leadership.

Chapter III tells of the application of Scientific Management in City Affairs. The science of management has for its object the development of the one best way in every part of its field, with the emphasis on the "one." In private manufacturing establishments the owner can frequently put into practice means and methods not understood or indorsed by the workers.

Under the title Coöperation the One Best Way, Chapter IV seeks to show that in a city, which is a great industrial plant owned by its citizens collectively, the genuine interest of intelligent citizens, is needed to back up any municipal program. There should also be coöperation between cities, as many of their problems admit of a common solution. The moving of trained municipal employees from city to city in the course of their professional progress, and the rise of the commission manager plan of city administration will hasten this coöperative movement. Standard specifications for contracts and materials are suggested; coöperation between householders, street-cleaning forces, municipal road repair forces, regular contractors' groups and the street-railway company helps in solving the snow-removal problem.

In Chapter V, devoted to the city employee, the means taken to discourage his political activity are described. Uniforming, it is said, generally results in raising the grade of certain classes of employees. Equalization of pay, promotion, pensioning, competitions and welfare work are also touched upon. The author says that even under the civil-service law men can be removed from the public service for the same reasons that they can properly be removed from the service of a private company, and tells how he dealt with cases of discharge and discipline.

Although an enthusiastic advocate of the civil service or merit system, Mr. Cooke believes that The Man in Ten Thousand, the man who is best fitted for the larger position, will be found through the personal effort of the appointing officer rather than in the list of eligibles furnished by a civil-service commission. Civil service does very well for positions paying less than $3000 per year, but in his opinion will, as applied to the higher position, take the form of coöperating with the appointing officer in finding the right man, and in fearlessly and exhaustively checking that officer's judgment, rather than in insisting on taking the initiative. He suggests that if the secretaries of the four national engineering societies could be authorized by their several councils to associate themselves as a civil service board to act as an advisory committee to federal, state and municipal civil-service commissions, it would be a decided step in the right direction in filling engineering positions.

Those who know Mr. Cooke through his previous utterances will turn with especial interest to his chapter upon Our Utilities and Their Owners. "If we have good reason," he says, "for speaking without venom and by the facts, we have equally strong incentive for speaking fearlessly. I have already mentioned politics, the juggling of contracts, the absence of expert service and the lack of understanding of the problems of government on the part of the people, as among the causes which retard our progress. But more important than any of these, in my opinion, is the baleful influence constantly wielded directly and indirectly in almost every city in the land by the private-utility interests through their support of the lowest type of political machinery and intrigue."

"The basic fact underlying any discussion of municipal utilities is the essential solidarity of the private interests which control them." What, for want of a better name, he calls "courtesy" precludes the financing of competing interests and the invasion of preëmpted or allotted territory. "Anything like a complete victory for either side in this matter means to the one side wholesale destruction, through public ownership, of certain kinds of paper values, and to the other new and heavy public duties. The present-day managers of a property actually worth hardly $25,000,000, but with outstanding securities of over $50,000,000, are in an exceedingly embarrassing position. They want more than sympathy; they want help."

Methods of financing, and the rôle of the holding company, the efficiency of which the author says, "as a device for the injection of water, compares with the high finance which preceded it as a high-pressure fire main does to a garden hose," are described. Bankers realize that a widespread program of municipal ownership and municipal operation is more or less imminent, and the author has been told by those high in the banking world that the intention is to make these plants yield every possible penny in revenue against the day when ownership will change.

"Where private companies furnish good service at fair rates, give them protection, a free field and a square deal. If they fail in these essentials, any self-respecting city will call the bluff by insisting upon public ownership and public operation."

Confidence in state regulation is on the wane. The work that comes before the public-service commissions is largely engineering, and yet there are almost no engineers on the commissions. The cities are at a disadvantage in obtaining expert testimony in regard to costs and values, as most of the experts have been brought up in the employ of the utilities.

The greatest present-day problem in utility matters is not *who* is to own and operate them, but *how* they are to be operated. A titanic battle is on between a democratic army and eleven billions of capital.

Chapter IX shows how the city can be developed as an ally of industrial progress by attention to its food supply, transportation, public parks and baths, commercial, educational and vocational guidance, the stabilizing of employment, and all those things which make for industrial competency and attract and develop a desirable industrial population.

The citizen must amount to Something More than a Voter. Such organizations as chambers of commerce, city clubs, business men's associations, improvement associations, technical societies, etc., have unlimited possibilities for helping the city.

"In the last analysis," says the author in the concluding chapter, "a city is simply an aggregation of homes, and the object of each individual home is to be the source of the maximum of service and human happiness. Fortunately, it is not necessary to await future developments in order to visualize a beautiful city filled with prosperous folk leading happy and inspiring lives —a 'singing city.'"

Fred R. Low.

American Highway Engineers' Handbook. Editor-in-chief, Arthur H. Blanchard. First edition. John Wiley and Sons, Inc., New York, 1919. Flexible cloth, 7 x 4 in., 1658 pp., illus., tables. $5.

The task undertaken has been the compilation of a reference book which would include reliable and comprehensive information on all branches of highway engineering and related subjects, including organization and administration of highway departments, financing of improvements, highway design, paving, testing, costs, etc. These questions are discussed in twenty-nine sections, each of which has been edited by an authority. Bibliographies for each section and an extensive index have been provided.

American Methods in Foreign Trade. A Guide to Export Selling Policy. By George C. Vedder. First edition. McGraw-Hill Book Co., Inc., New York, 1919. Cloth, 8 x 6 in., 204 pp. $2.

The author of this volume is a believer in the soundness of the distinctively American methods of developing an export trade which have hitherto been adopted by our most efficient world traders. He attempts in this volume to explain how these firms have achieved success and to outline the proper policy to be adopted by those interested in entering foreign markets.

Chilton Tractor Index. Published semi-annually by the Chilton Co., Philadelphia, 1919. Paper, 10 x 7 in., 464 pp. $1.

The Tractor Index is a directory of the manufacturers of tractors, tractor parts and accessories, and power farming machinery in the United States. It also includes an illustrated list of American tractors, in which brief specifications for each tractor are given, a table giving complete specifications for 198 tractors, and a similar table of specifications for power farming machinery. A collection of articles on tractors and farm machinery completes the work.

Chlorination of Water. By Joseph Race. First edition. John Wiley and Sons, Inc., New York, 1918. Cloth, 8 x 5 in., 158 pp. $1.50.

The author has collected and correlated the scattered information in print on the purification of water by chlorine, and presents a systematic account of the theory, practical application and results. Numerous references to the original publications are given.

The Fundamental Equations of Dynamics. Its Main Coördinate Systems Vectorially Treated and Illustrated from Rigid Dynamics. By Frederick Slate. Berkeley, University of California Press, 1918. Cloth, 8 x 6 in., 233 pp. $2.

The author of this volume feels that the extensiveness of the field of dynamics has necessitated such compression in the general surveys of its principles that the usual treatment leans too heavily on mathematics. His desire has been to prepare a supplement to such standard works which will direct attention to the physical aspects, and to experimental reasoning, by offering a flexible continuation of an elementary stage with unsettled achievement. The book forms Part II of Principles of Mechanics (Part I, Macmillan Co., 1900).

A Handbook of Physics Measurements. Vol. I, Fundamental Measurements, Properties of Matter, and Optics. Vol. II., Vibratory Motion, Sound, Heat, Electricity and Magnetism. By Ervin S. Ferry, in collaboration with O. W. Silvey, G. W. Sherman, Jr., and D. C. Duncan. First edition. John Wiley and Sons, Inc., New York, 1918. Cloth, 8 x 5 in., 233 pp. illus., tables. $2 a volume.

The aim of this work is to furnish the student of pure or applied science with a self-contained manual of the theory and manipulation of those measurements in physics which bear most directly upon his subsequent work in other departments of study and upon his future professional career. The experiments have been selected with regard to the particular determinations now demanded by science and industry and so grouped as to segregate those of value for students of the various branches of engineering.

Making the Small Shop Profitable. By John H. Van Deventer. First edition. Published by the *American Machinist.* (McGraw-Hill Book Co., New York, sole selling agents.) 1918. One-quarter cloth, 12 x 9 in., 113 pp., illus. $1.75.

This book contains a series of articles on important phases of the activities of small machine shops, proper methods of working, cost-keeping, etc., and also illustrations of many handy devices for facilitating work, particularly in shops with limited equipment. It is a continuation of the author's Success in the Small Shop. The articles first appeared in the *American Machinist.*

Steam Engines. Prepared in the Extension Division of the University of Wisconsin, by E. M. Shealy. (Engineering Education Series.) First edition. McGraw-Hill Book Co., Inc., New York, 1919. Cloth, 9 x 6 in., 290 pp. 173 illus. $2.50.

This is the third of a series of three textbooks on steam engineering, prepared for correspondence students in the University of Wisconsin Extension Division. The aim in this volume is to teach the fundamental principles underlying the operation of the steam engine, in as simple and non-mathematical a manner as possible. Particular attention is given to valve gears.

Locomotive Hand-Book. Compiled by American Locomotive Company, New York, 1917. Leather, 4 x 6 in., 195 pp., 9 illus., 89 tab. $0.75.

The compilers have arranged the tables, formulæ and other information used by locomotive designers, in a convenient book of pocket size.

Oxwelding and Cutting. Manual of Instruction. Compiled by the Oxweld Acetylene Company, Jersey City, N. J. First edition, (copyright 1918). Paper, 5 x 8 in., 124 pp., illus. $0.50.

The manual describes the apparatus, the methods of using it and gives a series of practice problems illustrating correct methods of meeting those that occur in shops where oxy-acetylene is used for cutting and welding.

Practical Aviation. An Understandable Presentation of Interesting and Essential Facts in Aeronautical Science. By Charles B. Hayward. Second edition. American Technical Society, Chicago, 1919. Flexible cloth, 6 x 8 in., 784 pp., illus. $3.75.

This volume treats of the theory, design and construction of airplanes and dirigible balloons, and their motors; and describes the types in use. Considerable space is given to the military uses of airplanes and to the methods of flying used by military aviators.

Practical Aviation for Military Airmen. By Major J. Andrew White. Wireless Press, New York, (copyright 1918). Cloth, 6 x 9 in., 197 pp., illus., pl. $1.75.

The author's aim has been to produce a textbook suited for intensive study by students of military aviation who wish to learn the essentials of flying in the shortest possible time. The reading matter has been condensed by eliminating everything but essentials, and providing a large number of drawings, conveniently arranged.

Scrap Metals. Study of Iron and Steel Old Material, Its Preparation and Markets. By George H. Manlove. The Old Metals, by Charles Vickers. The Penton Publishing Co., Cleveland, 1918. Cloth, 6 x 8 in., 278 pp. $2.

The two monographs which compose this volume treat of the utilization of old metal. The first is restricted to scrap iron and steel, while the second discusses non-ferrous metals. The book is a pioneer attempt to present the scrap industry in print.

Topographic Stadia Surveying. A Manual with Reduction Tables and a new Type of Reduction Diagram. By C. E. Grunsky. D. Van Nostrand Co., New York, 1917. Cloth, 4 x 7 in., 99 pp., 18 illus., 8 tab., folding diag. in cover pocket. $2.

The author describes a method of surveying and a special type of diagram for the reduction of stadia notes, which has been found to be very satisfactory in practice.

THE ENGINEERING INDEX

Published Monthly by The American Society of Mechanical Engineers

The Engineering Index was Founded in 1884 by the Association of Engineering Societies; Published from 1895 to 1919 by The Engineering Magazine Company; and Acquired January 1919 by The American Society of Mechanical Engineers

THE following pages form a descriptive Index to articles on engineering and related subjects in current periodicals. In its preparation the Society's engineering staff regularly examines all of the technical journals and society publications received by the Engineering Societies Library, which form one of the greatest and most complete collections of scientific periodicals in the world, comprising upward of 1100 distinct publications in some ten languages. Cross-references are freely introduced in the Index, and in all cases where the titles of articles are not sufficiently descriptive, explanatory sentences are appended. The main abbreviations used in the items are given at the bottom of this page.

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THE Society is prepared to supply photostatic copies (white printing on brown background) of any of the articles listed. Copies of the periodicals themselves, or clippings of articles, cannot be supplied.

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MECHANICAL ENGINEERING

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Forging
Foundries
Fuels and Firing
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Hoisting and Conveying
Hydraulic Machinery
Internal-Combustion Engines
Lubrication
Machine Elements and Design
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Machinery, Metal-Working
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Safety and Signaling Systems
Shops
Special Lines
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Chemistry
Mathematics
Physics

Note.—The abbreviations used in indexing are as follows:

Academy (Acad.)
American (Am.)
Associated (Assoc.)
Association (Assn.)
Bulletin (Bul.)
Bureau (Bur.)
Canadian (Can.)
Chemical or Chemistry (Chem.)
Electrical or Electric (Elec.)
Electrician (Elecn.)
Engineer[s] (Engr.[s])
Engineering (Eng.)
Gazette (Gaz.)
General (Gen.)
Geological (Geol.)
Heating (Heat.)
Industrial (Indus.)
Institute (Inst.)
Institution (Instn.)
International (Int.)
Journal (Jl.)
London (Lond.)
Machinery (Machy.)
Machinist (Mach.)
Magazine (Mag.)
Marine (Mar.)
Materials (Matls.)
Mechanical (Mech.)
Mining (Min.)
Municipal (Mun.)
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New York (N. Y.)
Proceedings (Proc.)
Record (Rec.)
Refrigerating (Refrig.)
Review (Rev.)
Railway (Ry.)
Scientific or Science (Sci.)
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State names (Ill., Minn., etc.)
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Western (West.)

Mechanical Engineering

AIR MACHINERY

Air Pumps

Air Ejectors (Les éjecteurs extracteurs d'air), L. Conge. Revue Générale de l'Électricité, vol. 4, no. 17, Oct. 26, 1918, pp. 629-632, 6 figs. Details of Westinghouse-Leblanc air pump, of Breguet ejector and of British Westinghouse apparatus.

See also MECHANICAL ENGINEERING, Heating and Ventilation (Air Cooling)

CORROSION

Wire Ropes

Interior Corrosion of Wire Ropes, Wm. Fleet Robertson. Can. Min. Jl., vol. 40, no. 1, Jan. 8, 1919, pp. 6-7. Report of tests undertaken on rope which broke, it is said, by oxidizing of wires, chiefly internally, caused by action of corrosive water and a humid atmosphere.

FORGING

Drop Hammers

4-ton Drop Hammer at Crewe Works. Engineering, vol. 106, no. 2765, Dec. 27, 1918, pp. 736-737, 7 figs. Description with illustrations of the hammer and some of its work. Its development and the necessary equipment.

European Situation

Some Drop Forge Possibilities Abroad, L. W. Alwyn-Schmidt. Am. Drop Forger, vol. 4, no. 12, Dec. 1918, pp. 471-473. Review of present conditions; situation in foreign countries; methods of procuring business in Europe.

Forge-Shop Capacity

Selecting a Source of Supply for Forgings, W. F. Rockwell. Am. Drop Forger, vol. 5, no. 1, Jan. 1919, pp. 1-3. Convenience of enlarging forge-shop capacity; preference of buyers to order forgings by sets.

Forge Shop

Pan Motor Forge Shop About Completed. Am. Drop Forger, vol. 4, no. 12, Dec. 1918, pp. 490-492. Details of layout and equipment; methods for handling raw and finished material. Shop to be largest in U. S.

A Progressive Forge Shop in Rockford. Am. Drop Forger, vol 4, no. 12, Dec. 1918, pp. 480-481, 6 figs. Equipment and general layout of departments.

Modern Forge Shop at the Essington Plant. Am. Drop Forger, vol. 4, no. 12, Dec. 1918, pp. 474-475, 3 figs. General description of works turning out marine equipment. Layout of shops allows for future expansion.

Forging Industry

A Review of the Drop Forging Industry, A. W. Peterson. Am. Drop Forger, vol. 5, no. 1, Jan. 1919, pp. 36-38, 2 figs. Data showing production development of forging industry over period of 35 years; importance of forging industry during years of war.

Furnaces

Heating and Preheating Forging Furnaces. Blast Furnace, vol. 7, no. 1, Jan. 1919, pp. 57-59, 4 figs. Recent installation designed to withstand distorting action of heat as well as wear. Combustion chambers on preheating furnace are staggered on each side.

Historical Data

Historical Data on Hammers and Forgings, Howard Terhune. Am. Drop Forger, vol. 5, no. 1, Jan. 1919, pp. 39-41. Review of improvements since issue of first patent in 1842; introduction of principle of modern board drop hammer in 1861; present tendencies.

See also ELECTRICAL ENGINEERING, Furnaces.

FOUNDRIES

Brass Foundries

Materials and Chemicals Used in Brass Foundry Practice, Charles Vickers. Brass World, vol. 14, no. 12, Dec. 1918, pp. 343-345. Deals with history, properties, appearance, physiological action and commercial use of substances commonly used in brass founding. First of series of articles.

Casting Methods

Molding and Pouring a Gasoline Engine Bed, F. H. Bell. Can. Machy., vol. 21, no. 5, Jan. 30, 1919, pp. 106-108, 4 figs. Shows method of casting a sheet-steel bottom into a gray-iron casting, making entire bed into a tank.

Core Ovens

The Application of Pyrometers to Core Ovens, G. W. Keller. Foundry, vol. 47, no. 318, Feb. 1919, pp. 72-74, 3 figs. From a paper before Am. Foundrymen's Assn.

Furnace, Electric

The Electric Furnace in the Grey Iron Foundry, F. H. Bell. Can. Machy., vol. 21, no. 1, Jan. 2, 1919, pp. 7-8, 4 figs. Practicability of melting gray iron for foundry purposes by electricity; process followed at Bowmanville Foundry Co.

Irons

Conversion of White Iron into Foundry, C. T. Huang. Iron Age, vol. 103, no. 4, Jan. 23, 1919, pp. 231-232. How Chinese native irons may be made available as a means of relieving the scarcity of other grades in that country.

Molding

Molding Shoes for Caterpillar Tractors. Iron Age, vol. 103, no. 2, Jan. 9, 1919, pp. 119-120, 3 figs. Davenport molding machine with hurriedly devised handling rigging gives satisfactory results; 1000 shoes made per day.

Patterns

The Laying Out of Patterns, Joseph A. Shelly. Machy., vol. 25, no. 6, Feb. 1919, pp. 493-497, 12 figs. Methods of making the drawings or layouts that are required by the patternmaker in planning his work, together with allowances necessary for draft and shrinkage and for machining castings in the shop.

Steel Castings on Pacific Coast

Steel Castings on the Pacific Coast. Iron Age, vol. 103, no. 4, Jan. 23, 1919, pp. 233-235, 2 figs. Growth of industry due to the war; good steel made without pig iron; overcoming manufacturing difficulties.

Tumbling Barrels

Tumbling Barrels in Foundries (Scheurfaesser und Putztrommeln in Giessereibetrieben), Rauch und Staub, vol. 8, no. 12, Sept. 1918, pp. 113-114. General discussion on construction, use and advantages of tumbling barrels for changing castings. States that castings up to 45 in. long and weighing 2000 lbs. can be cleaned in suitable revolving drums. Describes inclined drums 36 ft. long, 28 in. in diameter.

See also MARINE ENGINEERING, Ships (Castings); ELECTRICAL ENGINEERING, Furnaces.

FUELS AND FIRING

Argentine

Fuels in Argentine (Die Brennstoffe Argentinens), Rauch und Staub, vol. 8, no. 12, Sept. 1918, pp. 114-115. General discussion on the fuel situation in Argentina, abstracted from Berichte ueber Handel und Industrie, vol. 23, no. 4, Feb. 1918.

Ash

Fusibility of West Virginia Coal Ash, Walter Selvig. Coal Age, vol. 15, no. 1, Jan. 2, 1919, pp. 12-16, 2 figs. Method of preparing ash for fusion test and determining initial softening temperature and interval of fusion. Includes a tabulation of tests on West Virginia coals.

Bagasse

Bagasse Feeders, Furnace Design and Furnace Control, A. Gartley. La. Planter, vol. 62, no. 21, Jan. 11, 1919, pp. 25-28, 5 figs. Suggestions on design; curves giving pounds of water which can be evaporated per pound of bagasse having different percentages of moisture. Paper before Hawaiian Sugar Planters' Assn.

Briquets

Some Notes on the Manufacture of Fuel Briquettes, E. H. Robertson. Trans. Min. & Geol. Inst. India, vol. 13, pt. 1, Sept. 1918, pp. 49-61, 6 figs. Analysis of manufacturing methods; results obtained by some experimenters; examples of survivance of briquettes.

The Economy of Briquetting Small Coal, J. A. Yeadon. Tran. Min. Inst. Scotland, vol. 40, pt. 7, 1918-1919, pp. 145-148 and (discussion) pp. 148-150. Gain in calorific power by briquetting with pitch as agglomerant; rectangular and "ovoid" forms of briquettes.

Coal Selection

Selecting Coal for Power Plant Use, Robert June. Elec. Rev., vol. 74, no. 3, Jan. 18, 1919, pp. 94-97, 4 figs. Characteristics of various coals; influence of coal upon furnace-chamber design; purchase of coal. (First of series on power-plant management.)

Clay Products, Burning

Fuel Economy in Clay Products Burning—III, A. V. Bleininger and A. F. Greaves Walker. Can. Mfr., vol. 39, no. 1, Jan. 1919, pp. 87-88. Means of controlling burning.

Conservation

Fuel Conservation, Robert Collett. New England R.R. Club, Dec. 10, 1918, pp. 190-208. Waste of fuel by reason of engines delayed on road and by engines kept under steam unnecessarily at terminals; improper handling of engines; excessive firing; engines not in good condition; fuel not up to contract specification.

The Threatened Coal Shortage and the Possible Methods of Economising Fuel—II, John B. C. Kershaw. Cassier's Eng. Monthly, vol. 54, no. 6, Dec. 1918, pp. 308-315, 2 figs. Applicability of remedies proposed in October issue to English conditions; recommendations of U. S. Fuel Administration; coal-dust firing as an aid to fuel conservation.

Fuel Economy Will Continue a Serious Problem, W. A. Shoudy. Elec. World, vol. 73, no 1, Jan. 4, 1919, pp. 14-16, 3 figs. Can be improved by proper application of correctly designed apparatus maintaining high vacuum, eliminating small wastes and not operating too many boilers; other suggestions.

Draft

Saving the Waste in the Chimney—III, Robert Sibley and Chas. H. Delany. Jl. Elec., vol. 42, no. 2, Jan. 15, 1919, pp. 79-80, 1 fig. Determination of actual draft required for different fuels. Chart showing lb. of coal burned per sq. ft. grate surface per hr. against draft between furnace and ash pit in in. of water.

Steam Plant Efficiency. Coal Trade Jl., year 51, no. 2, Jan. 8, 1919, pp. 37-38, 4 figs. Relation between kinds of coal and completeness of combustion for six sets of conditions; gaging air supply for given furnace and fuel. (Concluded.)

Fuel Requirements for Factories

Fuel Requirements for Factories, Charles L. Hubbard. Indus. Management, vol. 57, no. 2, Feb. 1919, pp. 125-126. How to make tests of fuel requirements for extremes of weather, calculate needs for other conditions and outside temperatures, and estimate amount of fuel needed month by month throughout heating season.

Gas

Uses Gas in Twenty-One Manufacturing Processes, F. M. Lester. Gas Age, vol. 43, no. 2, Jan. 15, 1919, pp. 102-104, 6 figs. How gas is used in plant manufacturing gasoline motors and railway supplies and consuming 10,000,000 cu. ft. gas per month.

Gas Fuels

See Producer Gas below; items under INDUSTRIAL TECHNOLOGY; and Coal and Coke (Coke-Oven Gas) and Oil and Gas, under MINING ENGINEERING.

Heat Value, Determination of

Use of the Hydrogen-Volatile-Matter Ratio in Obtaining the Net Heating Value of American Coals, A. C. Fieldner and W. A. Selvig. Department of Interior, Bur. of Mines, tech. paper 197, 13 pp. 4 figs. Curves, constructed from 2000 analyses, showing relation between percentages of hydrogen and volatile matter of different coals.

Calorific Valuation of Coal Without a Calorimeter, Proctor Smith. Cassier's Eng. Monthly, vol. 54, no. 6, Dec. 1918, pp. 333-334. Approximate analysis by Goutal's formula.

Indiana Coals

Getting Better Combustion of Indiana Coals, T. A. Marsh. Elec. World, vol. 73, no. 2, Jan. 11, 1919, pp. 72-74, 7 figs. Practical methods by means of which furnace equipment installed years ago can be made to produce results comparable with good modern practice.

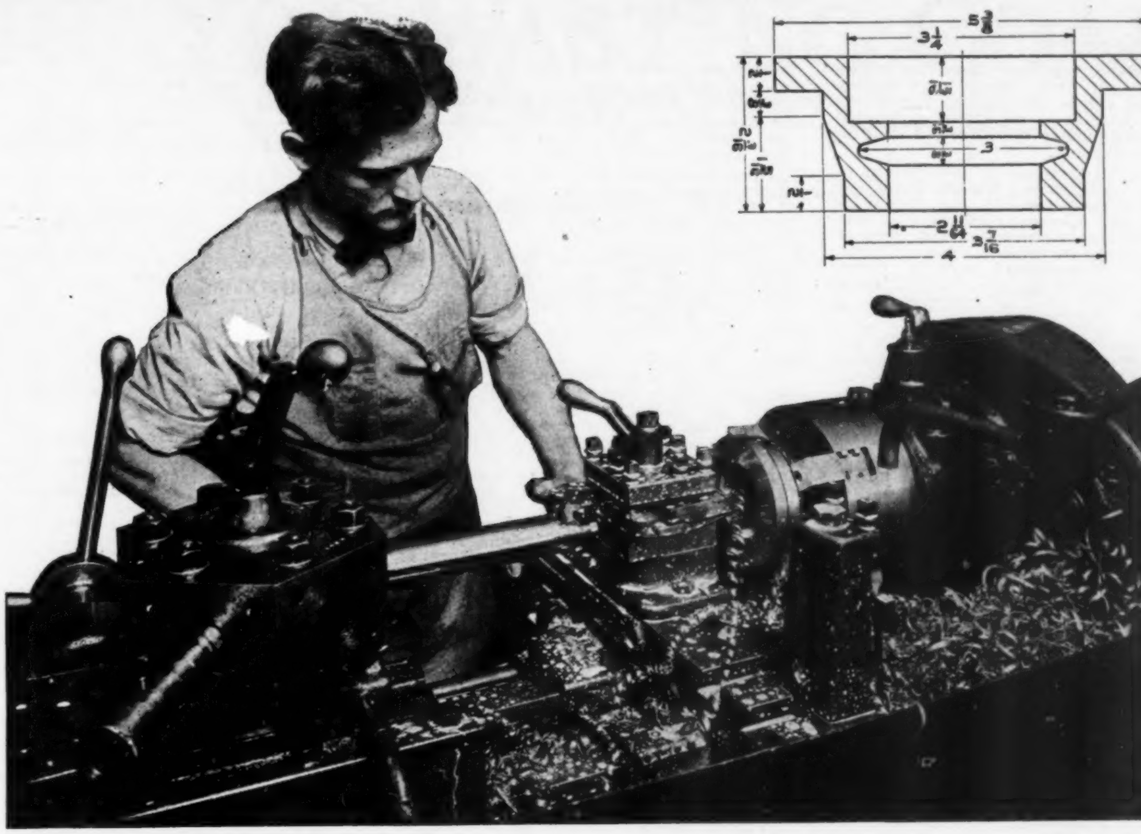
Lignites

Combustion of Lignite and High-Moisture Fuels, T. A. Marsh. Elec. World, vol. 73, no. 6, Feb. 8, 1919, pp. 265-267, 5 figs. Typical analyses of high-moisture fuels in the United States and Canada and summary of experience derived from burning fuels of the kinds described in power plants.

Notes on Lignite, S. M. Darling. Power Plant Eng., vol. 23, no. 3, Feb. 1, 1919, pp. 148-150. Characteristics and utilization. Abstract of Technical Paper 178, Bureau of Mines.

Motor Fuel

The Motor Fuel Problem, W. R. Ormandy. Colliery Guardian, vol. 116, no. 3021, Nov. 22, 1918, pp. 1076-1077. From paper before Instn. of Petroleum Technologists.



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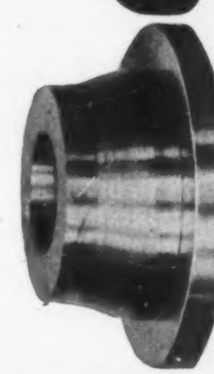

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Peat

Peat and the Electrical Industry (La tourbe et l'industrie électrique), Pierre Gieu. Revue Générale de l'Electricité, vol. 4, no. 22, Nov. 30, 1918, pp. 843-851, 3 figs. Artificial drying and gasification of peat; effects of humidity on its calorific value; permissible percentage of humidity. Results of an extended investigation undertaken under the direction of Minister of Mines, Canada.

Peat in 1917, C. C. Osborn. Department of Interior, U. S. Geol. Survey, Mineral Resources of the United States—Part II, Dec. 19, 1918, pp. 257-283, 1 fig. General conditions of peat industry; occurrence, properties and uses of peat; peat industry in principal foreign countries; selected bibliography; map of U. S. showing principal peat deposits.

Powdered Fuel

Progress Realized During the War in the Utilization of Fuels (Progrès réalisés pendant la guerre dans l'utilisation des combustibles), E. Damour. Industrie Electrique, year 28, no. 637, Jan. 10, 1919, pp. 5-7. Gasification and pulverization of fuels. From extensive account in Chemie et Industrie.

Powdered Coal Advance and Development, H. A. Kimber. Blast Furnace, vol. 7, no. 1, Jan. 1919, pp. 67-68. Use of powdered fuel for steam generation; improvements in distribution; control of fuel; summary of furnaces for which pulverized coal was installed during 1918.

A Review on the Use of Powdered Coal, W. O. Renkin. Am. Drop Forger, vol. 5, no. 1, Jan. 1919, pp. 22-25, 3 figs. Early uses and present methods; comparative data on fuels.

Suggestions for Burning Pulverized Coal, W. G. Wilcox. Am. Drop Forger, vol. 4, no. 12, Dec. 1918, pp. 492-494. Control of combustible and air in burning pulverized coal; method of projecting coal in suspended form into furnace; importance of mixing coal dust properly.

Stokers

Fuel Burning Equipment of Modern Power Stations, Joseph G. Worker. Elec. Jl., vol 16, no. 2, Feb. 1919, pp. 55-60, 15 figs. Examples of various installations using underfeed stokers, auxiliary equipment to control their operation.

Mechanical Stokers—II, Robert June. Brick & Clay Rec., vol. 53, no. 14, Dec. 31, 1918, pp. 1147-1149, 3 figs. Concludes from examination of various types that chain-grate stoker is suitable for boilers of good size up to 250 per cent rating and overfeed stoker for medium-sized installations up to 200 per cent rating.

Waste Heat, Utilization of

Utilization of Waste Heat at Municipal Gas Works of Tuebingen (Die Abhitzegewinnung und verwertung im staedt. Gaswerk Tuebingen), Henig. Journal fuer Gasbeleuchtung, vol. 61, no. 45, Nov. 9, 1918, pp. 529-534, 1 fig. History and performance of rational waste-heat system utilized for heating water for distant municipal bath. Tests. Costs.

Steam Raising with Waste Heat from Coal- and Oil-Fired Furnaces, Iron & Coal Trades Rev., vol. 97, no. 2648, Nov. 22, 1918, pp. 580, 4 figs. Description of standard heat-raising unit (Brett system), embodying coal-fired furnace with boiler.

See also MINING ENGINEERING, Coal and Coke (Coal Oxidation and Ignition); MECHANICAL ENGINEERING, Motor-Car Engineering (Fuels), Power Plants (Low-Grade Fuels)

GAGES

Profile Gages

Grinding Accurate Profile Gages by Means of Master Plates, Herbert M. Darling. Am. Mach., vol. 50, no. 3, Jan. 16, 1919, pp. 105-106, 3 figs. Description of operation.

Thread and Wing Gages

Thread Gages; Wing Gages, Erik Oberg. Machy., vol. 25, no. 6, February, 1919, pp. 502-506, 13 figs. Last of a series of articles describing principles involved and procedure followed by the Pratt & Whitney Company in developing gaging systems for interchangeable manufacture.

The Precision Measurement of Thread Gages. Can. Machy., vol. 21, no. 5, Jan. 30, 1919, pp. 113-115, 4 figs. Commercial equipment manufactured by Arthur Knapp Eng. Corporation after models developed by Bur. of Standards.

HANDLING OF MATERIALS

Ash Handling

Bennis Ash Handling Plant. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 84-85, 3 figs. Pneumatic ash plant; steam suction conveyors, ash elevators and ash hoists.

Coal Handling

Coal Handling at Ports, H. Hubert. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 42-45, 6 figs. An account of a number of modern plants for dealing with coal at ports.

Coal-Handling Appliances at the Coventry Electricity Works, George Frederick Zimmer. Engineering, vol. 107, no. 2767, Jan. 10, 1919, pp. 37-42, 27 figs. Drawings, general data and description of the plant.

Coal Tipple and Washery at Lehigh, Mont., E. P. Stewart. Coal Age, vol. 15, no. 1, Jan. 2, 1919, pp. 9-11, 4 figs. Apparatus designed to clean coal thoroughly and prepare locomotive fuel.

Coal Handling Plant at Sewall's Point, Virginia. Power, vol. 49, no. 2, Jan. 14, 1919, pp. 54-56, 5 figs. Description of new facilities of Virginia Railway at coal pier near Norfolk, Va. From Coal Age.

Coke

The Mechanical Handling of Coke, Alwyne Meade. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 57-61, 8 figs. The problems involved; description of conveyors designed to overcome difficulties; aspects of cost.

Explosives

Munition Handling Devices. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 73-75, 5 figs. A few examples in which well-known types of conveying apparatus are modified to serve specific purposes in the manufacture of explosives.

Gravity Roller Runway

The Gravity Roller Runway, George Frederick Zimmer. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 33-41, 28 figs. The component parts of gravity roller runways; accessory plant such as shoots, "humpers," stackers and "gadgets."

Mechanical Handling

The Mechanical Handling of Materials, Percy G. Donald. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 29-32, 8 figs. After discussing objections to mechanical handling, the author deals with such plant as an investment, the speed that is desirable, the importance of a suitable layout, and finally indicates the various types of plant that are available.

Paper Mill

Material Handling in a Paper Mill, Henry J. Edsall. Indus. Management, vol. 57, no. 2, Feb. 1919, pp 97-103, 18 figs. Labor-saving equipment of Dill & Collins Co. (To be continued.)

Pneumatic Handling of Cereals

Pneumatic Handling of Cereals, C. Bentham. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 61-67, 15 figs. Importance of pneumatic systems in unloading ships; types of plant in operation; the exhauster; problems involved in the design of a suitable nozzle.

Portable Pneumatic Grain Unloading Plant. Conveying, Cassier's Eng. Monthly Supp., vol. 1, no. 7, Dec. 1918, pp. lxxxiii-lxxxvi, 4 figs. Equipment includes 6-cylinder Aster petrol engine of 85 hp. with rotary blower, mounted on 4-wheeled, 25-ton railway truck.

HEAT TREATING

Developments in 1918

1918 Developments in Heat Treating, James H. Herron. Am. Drop Forger, vol. 5, no. 1, Jan. 1919, pp. 53-54. Changes in methods used for heat-treating materials; scope of heat-treating activities.

Furnaces

Heating Furnaces and Annealing Furnaces —II. W. Trinks. Blast Furnace, vol. 7, no. 1, Jan. 1919, pp. 69-72 and 80, 7 figs. Design, operation and construction. Furnace capacity; rate of heat transfer; temperature to which metal is to be heated.

Malleable Iron

Reducing the Malleable Iron Annealing Period, A. E. White and R. S. Archur. Foundry, vol. 47, no. 318, Feb. 1919, pp. 61-65, 12 figs. Report of an investigation made at the University of Michigan. From a paper before the American Foundrymen's Assn.

Steel for Motors

Treatments of Steels Used in the Construction of Light-Weight Engines. (Emplois et traitements des aciers utilisés dans la construction des moteurs légers), M. L. Barbillion. Bulletin Technique de la Suisse Romande, year 44, nos. 15 and 17, July 27 and Aug. 24, 1918, pp. 140-142 and 158-160, 4 figs. July 27: Steel employed for shafts, nuts, bolts and cams. Aug. 24: Soft carbon steels; chrome-nickel steels; nickel steels; tungsten steels; special steel having 0.20C + 0.13 Si + 0.36 mm. + 12 Ni.

Lincoln Motor Co.'s Heat Treating Plant, F. L. Prentiss. Iron Age, vol. 103, no. 2, Jan. 9, 1919, pp. 107-111, 7 figs. Department equipped for quantity production in plant designed for changing from airplane to commercial motor work.

See also METALLURGY, Iron and Steel (Heat Treatment)

HEATING AND VENTILATION

Air Cooling

Special Applications of Small Air-Cooling Systems. Heat. & Vent. Mag., vol. 16, no. 1, Jan. 1919, pp. 43-46, 4 figs. Arrangements with forced and gravity circulation of air.

Boiler Rating

Heating Versus Power Boiler Rating, P. J. Dougherty. Power, vol. 49, no. 3, Jan. 21, 1919, pp. 84-85. Showing why rules in general used for determining and comparing rating or capacity of high-pressure boilers are not applicable to low-pressure or so-called heating boilers.

Central-Station Heating

Central Station Heating; Its Economic Features with Reference to Community Service, John C. White. Department of Interior, Bur. of Mines, tech. paper 191, 23 pp., 6 figs. Data on costs and results obtained with central heating stations.

Factory Heating

Modern Factory Heating, Alfred G. King. Domestic Eng., vol. 86, nos. 1 and 2, Jan. 4, 11, 1919, pp. 27-30 and 76-79, 11 figs. Requirements for factory heating; construction details.

Tunnel Ventilation

The Ventilation of Tunnels and Buildings, Francis Fox. Universal Engr., vol. 28, no. 6, Dec. 1918, pp. 40-46. Ventilation systems in operation at several European tunnels; prescribed hygienic practice concerning renovation of air in dwellings.

Ventilation Plant for Simplon Tunnel (Die Ventilationsanlage des Simplon Tunnels), F. Rothpletz. Schweizerische Bauzeitung, vol. 73, no. 1, Jan. 4, 1919, pp. 3-4, 3 figs. Remodeling and enlarging of the ventilation system, located at the north entrance only of the twin-tunnel, operated electrically. Southward air current chosen to avoid rusting of structural steel due to condensation if southern air were sent northward. Total air volume 180 cu. m. per sec. at velocity in tunnel of 3 to 4 m. per sec. Part 1.

Two-Pipe System

Care of Heating and Ventilating Equipment, Harold L. Alt. Power, vol. 49, no. 5, Feb. 4, 1919, pp. 156-159, 14 figs. A discussion of the two-pipe system. Seventh article.

Vapor Heating

Modern Practice in Vapor Heating. Heat. & Vent. Mag., vol. 16, no. 1, Jan. 1919, pp. 48-52, 6 figs. The Broomell system.

See also MARINE ENGINEERING, Ships (Ventilating and Heating)

HOISTING AND CONVEYING

Conveyor Types

Conveyors for Engineering Works. Engineer, vol. 126, no. 3283, Nov. 29, 1918, pp. 462, 3 figs. Deals with types in use in engineering works, such as conveyors for rapid assembly of motors, case elevators, and shell conveyors. (From paper before Manchester Assn. of Engrs., by W. H. Atherton.)

Design

Some Details of Conveyors and Elevators, W. H. Atherton. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 46-49, 20 figs. Design of a number of essential details in conveyors and elevators, dealing with chains, sprocket wheels, buckets, skidders, frames and bearings.

Design of Electrically-Driven Lifting Blocks. Elecn., vol. 81, no. 2115, Nov. 29, 1918, pp. 639-640, 7 figs. Abstract of article in Elektrotechnische Zeitschrift, No. 1, 1918.

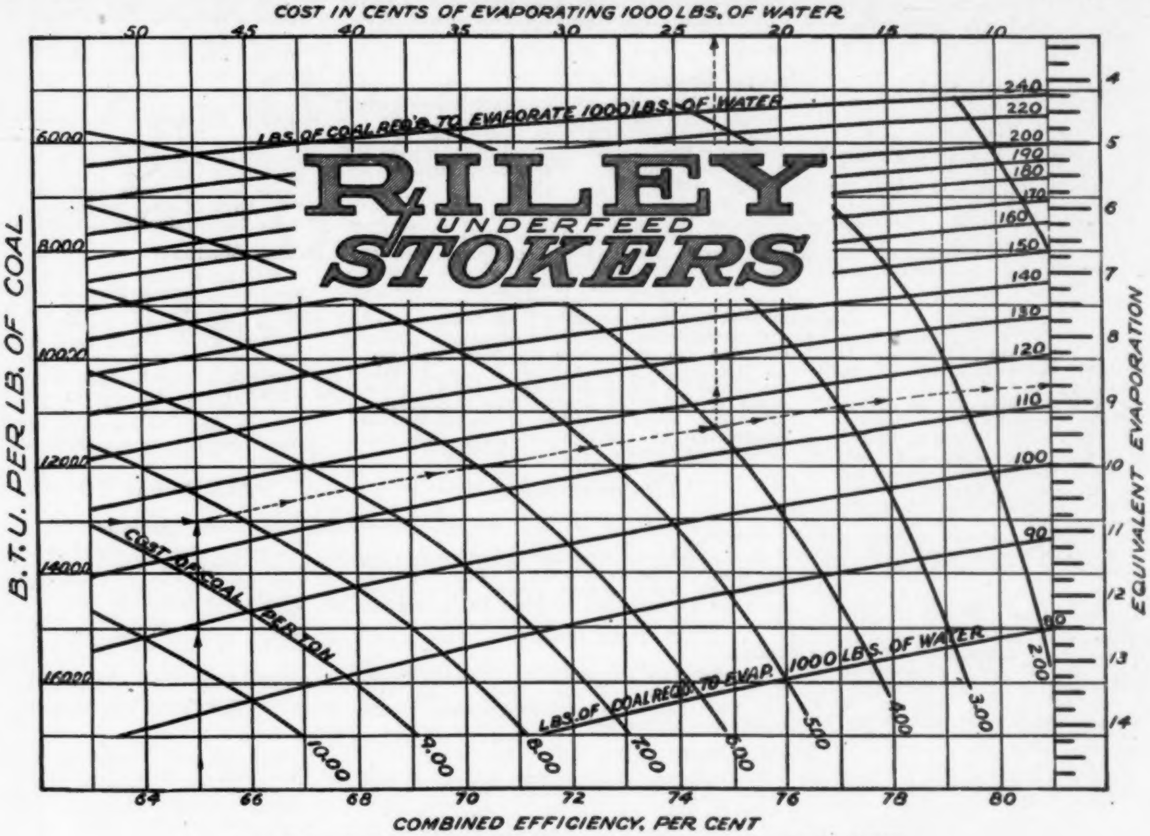
Electric Haulage

Notes on Three-Phase Electric Haulage Equipment, L. Fokes. Colliery Guardian, vol. 116, no. 3025, Dec. 20, 1918, pp. 1295-1296, 5 figs. Haulage room; motor; slip rings and brush gear; control equipment; isolating switch; reversing switch; controller; resistances; liquid resistance.

History

History of Conveying—II, George Frederick Zimmer. Conveying, Cassier's Eng. Monthly Supp., vol. 1, no. 7, Dec. 1918, pp. lxxv-lxxvii, 9 figs. Bucket elevators; elevator and conveyor chains. (Continued.)

ARE YOU WASTING COAL?



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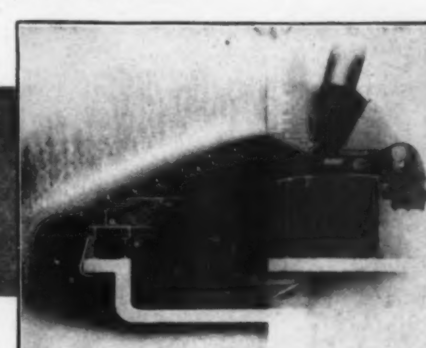

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Peat and the Electrical Industry (La tourbe et l'industrie électrique), Pierre Gleu. Revue Générale de l'Electricité, vol. 4, no. 22, Nov. 30, 1918, pp. 843-851, 3 figs. Artificial drying and gasification of peat; effects of humidity on its calorific value; permissible percentage of humidity. Results of an extended investigation undertaken under the direction of Minister of Mines, Canada.

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Progress Realized During the War in the Utilization of Fuels (Progrès réalizés pendant la guerre dans l'utilisation des combustibles), E. Damour. Industrie Electrique, year 28, no. 637, Jan. 10, 1919, pp. 5-7. Gasification and pulverization of fuels. From extensive account in Chemie et Industrie.

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Stokers

Fuel Burning Equipment of Modern Power Stations, Joseph G. Worker. Elec. Jl., vol 16, no. 2, Feb. 1919, pp. 55-60, 15 figs. Examples of various installations using underfeed stokers, auxiliary equipment to control their operation.

Mechanical Stokers—II, Robert June. Brick & Clay Rec., vol. 53, no. 14, Dec. 31, 1918, pp. 1147-1149, 3 figs. Concludes from examination of various types that chain-grate stoker is suitable for boilers of good size up to 250 per cent rating and overfeed stoker for medium-sized installations up to 200 per cent rating.

Waste Heat, Utilization of

Utilization of Waste Heat at Municipal Gas Works of Tuebingen (Die Abhitzegewinnung und verwertung im staedt. Gaswerk Tuebingen), Henig. Journal fuer Gasbeleuchtung, vol. 61, no. 45, Nov. 9, 1918, pp. 529-534, 1 fig. History and performance of rational waste-heat system utilized for heating water for distant municipal bath. Tests. Costs.

Steam Raising with Waste Heat from Coal- and Oil-Fired Furnaces, Iron & Coal Trades Rev., vol. 97, no. 2648, Nov. 22, 1918, pp. 580, 4 figs. Description of standard heat-raising unit (Brett system), embodying coal-fired furnace with boiler.

See also MINING ENGINEERING, Coal and Coke (Coal Oxidation and Ignition); MECHANICAL ENGINEERING, Motor-Car Engineering (Fuels), Power Plants (Low-Grade Fuels)

GAGES

Profile Gages

Grinding Accurate Profile Gages by Means of Master Plates, Herbert M. Darling. Am. Mach., vol. 50, no. 3, Jan. 16, 1919, pp. 105-106, 3 figs. Description of operation.

Thread and Wing Gages

Thread Gages; Wing Gages, Erik Oberg. Machy., vol. 25, no. 6, February, 1919, pp. 502-506, 13 figs. Last of a series of articles describing principles involved and procedure followed by the Pratt & Whitney Company in developing gaging systems for interchangeable manufacture.

The Precision Measurement of Thread Gages. Can. Machy., vol. 21, no. 5, Jan. 30, 1919, pp. 113-115, 4 figs. Commercial equipment manufactured by Arthur Knapp Eng. Corporation after models developed by Bur. of Standards.

HANDLING OF MATERIALS

Ash Handling

Bennis Ash Handling Plant. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 84-85, 3 figs. Pneumatic ash plant; steam suction conveyors, ash elevators and ash hoists.

Coal Handling

Coal Handling at Ports, H. Hubert. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 42-45, 6 figs. An account of a number of modern plants for dealing with coal at ports.

Coal-Handling Appliances at the Coventry Electricity Works, George Frederick Zimmer. Engineering, vol. 107, no. 2767, Jan. 10, 1919, pp. 37-42, 27 figs. Drawings, general data and description of the plant.

Coal Tipple and Washery at Lehigh, Mont., E. P. Stewart. Coal Age, vol. 15, no. 1, Jan. 2, 1919, pp. 9-11, 4 figs. Apparatus designed to clean coal thoroughly and prepare locomotive fuel.

Coal Handling Plant at Sewall's Point, Virginia. Power, vol. 49, no. 2, Jan. 14, 1919, pp. 54-56, 5 figs. Description of new facilities of Virginia Railway at coal pier near Norfolk, Va. From Coal Age.

Coke

The Mechanical Handling of Coke, Alwyne Meade. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 57-61, 8 figs. The problems involved; description of conveyors designed to overcome difficulties; aspects of cost.

Explosives

Munition Handling Devices. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 73-75, 5 figs. A few examples in which well-known types of conveying apparatus are modified to serve specific purposes in the manufacture of explosives.

Gravity Roller Runway

The Gravity Roller Runway, George Frederick Zimmer. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 33-41, 28 figs. The component parts of gravity roller runways; accessory plant such as shoots, "humpers," stackers and "gadgets."

Mechanical Handling

The Mechanical Handling of Materials, Percy G. Donald. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 29-32, 8 figs. After discussing objections to mechanical handling, the author deals with such plant as an investment, the speed that is desirable, the importance of a suitable layout, and finally indicates the various types of plant that are available.

Paper Mill

Material Handling in a Paper Mill, Henry J. Edsall. Indus. Management, vol. 57, no. 2, Feb. 1919, pp 97-103, 18 figs. Labor-saving equipment of Dill & Collins Co. (To be continued.)

Pneumatic Handling of Cereals

Pneumatic Handling of Cereals, C. Bentham. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 61-67, 15 figs. Importance of pneumatic systems in unloading ships; types of plant in operation; the exhauster; problems involved in the design of a suitable nozzle.

Portable Pneumatic Grain Unloading Plant. Conveying, Cassier's Eng. Monthly Supp., vol. 1, no. 7, Dec. 1918, pp. lxxxiii-lxxxvi, 4 figs. Equipment includes 6-cylinder Aster petrol engine of 85 hp. with rotary blower, mounted on 4-wheeled, 25-ton railway truck.

HEAT TREATING

Developments in 1918

1918 Developments in Heat Treating, James H. Herron. Am. Drop Forger, vol. 5, no. 1, Jan. 1919, pp. 53-54. Changes in methods used for heat-treating materials; scope of heat-treating activities.

Furnaces

Heating Furnaces and Annealing Furnaces —II. W. Trinks. Blast Furnace, vol. 7, no. 1, Jan. 1919, pp. 69-72 and 80, 7 figs. Design, operation and construction. Furnace capacity; rate of heat transfer; temperature to which metal is to be heated.

Malleable Iron

Reducing the Malleable Iron Annealing Period, A. E. White and R. S. Archur. Foundry, vol. 47, no. 318, Feb. 1919, pp. 61-65, 12 figs. Report of an investigation made at the University of Michigan. From a paper before the American Foundrymen's Assn.

Steel for Motors

Treatments of Steels Used in the Construction of Light-Weight Engines. (Emplois et traitments des aciers utilisés dans la construction des moteurs légers), M. L. Barbillon. Bulletin Technique de la Suisse Romande, year 44, nos. 15 and 17, July 27 and Aug. 24, 1918, pp. 140-142 and 158-160, 4 figs. July 27: Steel employed for shafts, nuts, bolts and cams. Aug. 24: Soft carbon steels; chrome-nickel steels; nickel steels; tungsten steels; special steel having 0.20C + 0.13 Si + 0.36 mm. + 12 Ni.

Lincoln Motor Co.'s Heat Treating Plant, F. L. Prentiss. Iron Age, vol. 103, no. 2, Jan. 9, 1919, pp. 107-111, 7 figs. Department equipped for quantity production in plant designed for changing from airplane to commercial motor work.

See also METALLURGY, Iron and Steel (Heat Treatment)

HEATING AND VENTILATION

Air Cooling

Special Applications of Small Air-Cooling Systems. Heat. & Vent. Mag., vol. 16, no. 1, Jan. 1919, pp. 43-46, 4 figs. Arrangements with forced and gravity circulation of air.

Boiler Rating

Heating Versus Power Boiler Rating, P. J. Dougherty. Power, vol. 49, no. 3, Jan. 21, 1919, pp. 84-85. Showing why rules in general used for determining and comparing rating or capacity of high-pressure boilers are not applicable to low-pressure or so-called heating boilers.

Central-Station Heating

Central Station Heating; Its Economic Features with Reference to Community Service, John C. White. Department of Interior, Bur. of Mines, tech. paper 191, 23 pp., 6 figs. Data on costs and results obtained with central heating stations.

Factory Heating

Modern Factory Heating, Alfred G. King. Domestic Eng., vol. 86, nos. 1 and 2, Jan. 4, 11, 1919, pp. 27-30 and 76-79, 11 figs. Requirements for factory heating; construction details.

Tunnel Ventilation

The Ventilation of Tunnels and Buildings, Francis Fox. Universal Engr., vol. 28, no. 6, Dec. 1918, pp. 40-46. Ventilation systems in operation at several European tunnels; prescribed hygienic practice concerning renovation of air in dwellings.

Ventilation Plant for Simplon Tunnel (Die Ventilationsanlage des Simplon Tunnels), F. Rothpletz. Schweizerische Bauzeitung, vol. 73, no. 1, Jan. 4, 1919, pp. 3-4, 3 figs. Remodeling and enlarging of the ventilation system, located at the north entrance only of the twin-tunnel, operated electrically. Southward air current chosen to avoid rusting of structural steel due to condensation if southern air were sent northward. Total air volume 180 cu. m. per sec. at velocity in tunnel of 3 to 4 m. per sec. Part 1.

Two-Pipe System

Care of Heating and Ventilating Equipment, Harold L. Alt. Power, vol. 49, no. 5, Feb. 4, 1919, pp. 156-159, 14 figs. A discussion of the two-pipe system. Seventh article.

Vapor Heating

Modern Practice in Vapor Heating. Heat. & Vent. Mag., vol. 16, no. 1, Jan. 1919, pp. 48-52, 6 figs. The Broomell system.

See also MARINE ENGINEERING, Ships (Ventilating and Heating)

HOISTING AND CONVEYING

Conveyor Types

Conveyors for Engineering Works. Engineer, vol. 126, no. 3283, Nov. 29, 1918, pp. 462, 3 figs. Deals with types in use in engineering works, such as conveyors for rapid assembly of motors, case elevators, and shell conveyors. (From paper before Manchester Assn. of Engrs., by W. H. Atherton.)

Design

Some Details of Conveyors and Elevators, W. H. Atherton. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 46-49, 20 figs. Design of a number of essential details in conveyors and elevators, dealing with chains, sprocket wheels, buckets, skidders, frames and bearings.

Design of Electrically-Driven Lifting Blocks. Elecn., vol. 81, no. 2115, Nov. 29, 1918, pp. 639-640, 7 figs. Abstract of article in Elektrotechnische Zeitschrift, No. 1, 1918.

Electric Haulage

Notes on Three-Phase Electric Haulage Equipment, L. Fokes. Colliery Guardian, vol. 116, no. 3025, Dec. 20, 1918, pp. 1295-1296, 5 figs. Haulage room; motor; slip rings and brush gear; control equipment; isolating switch; reversing switch; controller; resistances; liquid resistance.

History

History of Conveying—II, George Frederick Zimmer. Conveying, Cassier's Eng. Monthly Supp., vol. 1, no. 7, Dec. 1918, pp. lxxv-lvvvii, 9 figs. Bucket elevators; elevator and conveyor chains. (Continued.)

Trucks

See Transportation, under ORGANIZATION AND MANAGEMENT.

Wire Rope

The Wire Rope and Its Uses for Conveying Purposes. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 77-79. General principles; single and double ropeway systems; single fixed rope system.

HYDRAULIC MACHINERY

Hydraulic Plants

Extension to the Ontario Power Co.'s Plant, Thos. H. Hogg. Can. Engr., vol. 36, no. 3, Jan. 16, 1919, pp. 139-144 and 149-151, 23 figs. Construction of 13 miles of 13.5-ft. diameter wood-stave pipe for 50,000-hp. capacity; steel differential surge tank, 60 ft. in diameter, 94 ft. high; installation of two 20,000-hp. turbines with direct-connected generators.

Turbines

Banki's New Hydraulic Turbine (Neue Wasserturbine von Donat Banki, Professor in Budapest). Schweiz, Bauzeitung, vol. 72, no. 24, Dec. 14, 1918, pp. 235-236, 4 figs. The new turbine fills the gap between the Pelton wheel and the Francis turbine. Very compact.

New 2500-Hp. Turbine in the Kubel Hydro-electric Power House, near Saint-Gall, Switzerland (La nouvelle turbine de 2500 ch. de l'usine hydro-electrique de Kubel pres Saint-Gall Suisse). Revue Generale de l'Electricite, vol. 5, no. 1, Jan. 4, 1919, pp. 19-25, 9 figs. Results of trials of compact design of turbine with overhanging rotor to determine output, regulation and efficiency. Description of new regulator.

Turbine Operation

Economical Operation of Hydraulic Turbines, E. A. Gibbs. Can. Engr., vol. 36, no. 2, Jan. 9, 1919, pp. 127-128. Cleanliness, care and upkeep important factors in obtaining maximum efficiency. Also abstrated in Elec. World, vol. 73, no. 1, Jan. 4, 1919, pp. 25-26.

Turbine Tests

Standard Testing Code for Hydraulic Turbines, F. H. Rogers. Elec. Wld., vol. 73, no. 4, Jan. 25, 1919, pp. 164-166. Engineering societies are urged to adopt code of Machinery Builders' Society.

Water Hammer

Charts for Calculating Water Hammer. Jl. Elec., vol. 42, no. 2, Jan. 15, 1919, pp. 74-75, 2 figs. Constructed to give maximum possible rise or fall in pressure due to water hammer as determined from $h = a\ V/g$, a being velocity of wave (in an additional diagram) and V velocity of flow in pipe.

See also MECHANICAL ENGINEERING, Power Generation (Tides)

INTERNAL-COMBUSTION ENGINES

Design

Port Design for Two-Cycle Oil Engines. D. O. Barrett. Gas Engine, vol. 21, no. 2, Feb. 1919, pp. 37-42. Description of some types of two-cycle engines; formulæ for inlet, transfer and exhaust ports.

Oil Engines

The High-Compression Oil Engine, W. G. Gernandt. Jl. Soc. Automotive Engrs., vol. 4, no. 2, Feb. 1919, pp. 112-117 and discussion) pp. 117-118.

Internal Combustion Engine Development. Eng. Rev., vol. 32, no. 6, Dec. 16, 1918, pp. 164-166, 8 figs. Piston designs; leading particulars of engines developing 80 hp. per cylinder. (Concluded.)

LUBRICATION

Motor-Cylinder Lubrication

Motor-Cylinder Lubrication, G. S. Bryan Universal Engr., vol. 28, no. 4, Oct. 1918, pp. 37-45, 1 fig. Study of conditions under which lubrication takes place and of characteristics of motor-cylinder oils that determine their suitability for these conditions.

See also RAILROAD ENGINEERING Locomotives (Lubricators); MECHANICAL ENGINEERING, Motor-Car Engineering (Lubrication)

MACHINE ELEMENTS AND DESIGN

Ball Bearings

Why Do Ball Bearings Sometimes Fail? F. J. Jarosch. Am. Mach., vol. 50, no. 5, Jan. 30, 1919, pp. 209-213, 23 figs. An analysis of failures arising from poor selection and mistreatment.

Floating-Frame Reduction Gear

The Design and Progress of the Floating-Frame Reduction Gear, John H. Macalpine. Proc. Engrs., Soc. Western Pa., vol. 34, no. 7, Oct. 1918, pp. 519-535. Discussion. (Continued from Proc. Feb. 1918, p. 71.) Discussor contends rigid-frame gears are running continuously, with equally high tooth pressures, at the same speeds as floating-frame gears.

Machine Design

Developing Designs for Machinery and Tools, F. E. Johnson. Machy., vol. 25, no. 6, Feb. 1919, pp. 517-518, 5 figs. Cost of designing a new machine; evolution of design of a specific machine; overcoming defects in original design.

Screws

Optical Projection for Screw-Thread Inspection, James Hartness. Mech. Eng., vol. 41, no. 2, Feb. 1919, pp. 127-135, 10 figs. Analysis of screw-thread elements essential to strength and dependability; description of method for their accurate inspection.

Determination of Screw Dimensions (Détermination des dimensions à donner aux vis). La Métallurgie, year 51, no. 1, Jan. 1, 1919, pp. 21-23. Formulæ in three cases: (1) when screw is subject to tension and compression, (2) when screw is subjected to tension or compression by motion of nut, (3) when subjected to shear.

MACHINE SHOP

Die Making

The question of Our Die Room Equipment. Am. Drop Forger, vol. 5, no. 1, Jan. 1919, pp. 26-32, 23 figs. Improvements in die-room practices during years of war; suggestions to executives in regard to selecting equipment.

Grinding

Abrasives for Grinding Malleable Castings, W. T. Montague. Foundry, vol. 47, no. 318, Feb. 1919, pp. 74-75. Adapted from a recent publication of the Norton Co.

Machine Shops

Westinghouse Marine Engineering Works, Edward K. Hammond. Machy., vol. 25, no. 6, February, 1919, pp. 538-544, 12 figs. Description of a new plant at South Philadelphia for manufacturing the Westinghouse Marine System.

Milling Cutters

How Milling Cutters Are Made, F. B. Jacobs. Iron Trade Rev., vol. 64, no. 2, Jan. 9, 1919, pp. 150-154, 14 figs. How quantity production is secured by modern standard machinery and careful routing of work.

Some Milling Applications and Adaptations. Engineer, vol. 127, no. 3288, Jan. 3, 1919, pp. 6-9, 22 figs. Description of the development and use of the Francis milling cutter in munitions work.

Repair Shop

Camp Holabird Motor Truck Repair Shops. Jl. Soc. Automotive Engrs., vol. 4, no. 2, Feb. 1919, pp. 86-87. Repair shop procedure. Shop does 80 per cent of repair work required by Army trucks.

Tool Casting

Casting Tools from an Air-Hardening Steel. Foundry, vol. 47, no. 318, Feb. 1919, pp. 66-67, 3 figs. New alloy used successfully in the manufacture of dies and forming tools without forging; tungsten not present in the metal.

Tool Making

The Alfred Herbert Machine Tool Shop. Cassier's Eng. Monthly, vol. 54, no. 6, Dec. 1918, pp. 325-332, 8 figs. Facts about British key industries. (Second article.)

Machine Shop Economies. Universal Engr., vol. 28, no. 6, Dec. 1918, pp. 35-39. Manufacture of jigs and special tools; possible economy in selecting speeds and feeds.

See also MECHANICAL ENGINEERING, Mechanical Processes (Dies)

MACHINERY, METAL-WORKING

Boring Machine

Cylinder Boring and Reaming Tools, Franklin D. Jones. Machy., vol. 25, no. 6, Feb. 1919, pp. 507-515, 26 figs. Types and designs of cutter heads used for rough-boring and reaming small engine cylinders.

Boring Mill for Precision Work. Iron Trade Rev., vol. 64, no. 2, Jan. 9, 1919, pp. 156-157, 3 figs. Base and column of horizontal boring machine are heavily ribbed and metal distributed to reduce vibration. Operating mechanism is provided with ball thrust bearings.

Drilling Machine

The Hill Multiple-Spindle Drilling Machine. Am. Mach., vol. 50, no. 5, Jan. 30, 1919, pp. 189-190, 2 figs. Spindle drive design permits of close spacing of the drilling heads with a simple mechanism.

Lathes

The Bullard 8-Inch Mult-Au-Matic. Am. Mach., vol. 50, no. 5, Feb. 6, 1919, pp. 236-241, 6 figs. A detailed description of the machine.

Marking Machine

Making Milling and Gear Cutting Attachment—II. Robert Mawson. Can. Machy., vol. 21, no. 4, Jan. 23, 1919, pp. 78-81, 17 figs. Tools and methods used by Presto Machine Co., with special reference to marking machine for graduating dividing head base.

Milling Machines

Making Milling and Gear Cutting Attachment—III, Robert Mawson. Can. Machy., vol. 21, no. 5, Jan. 30, 1919, pp. 97-100, 15 figs. Tools and methods followed when machining vertical slide column base, dividing head, index bearing and plates of attachment.

Building the Kempsmith Milling Machine, M. E. Hoag. Am. Mach., vol. 50, nos. 3 and 5, Jan. 16 and 30, 1919, pp. 101-104 and 195-198, 23 figs. Description of some of operations followed in construction of milling machines.

MACHINERY, WOODWORKING

Felling Trees, Machine

Machine for Felling Trees (Machine abatteuse-billonneuse électrique pour le sciage et l'abatage des bois). Revue Générale de l'Electricité, vol. 4, no. 21, Nov. 23, 1918, pp. 165D-166D, 2 figs. An abstract is given of French patent no. 469,995, describing electrically-driven circular saw for felling trees.

MATERIALS OF CONSTRUCTION AND TESTING OF MATERIALS

Cast Iron

Wearing and Anti-Frictional Qualities of Cast Iron, J. E. Hurst. Iron & Coal Trades Rev., vol. 97, no. 2647, Nov. 15, 1918, pp. 546. Abstract of "Preliminary Note" to a Carnegie Scholarship Memoir.

Porcelain

Some Types of Porcelain, F. H. Riddle and W. W. McDanel. Jl. Am. Ceramic Soc., vol. 1, no. 9, Sept. 1918, pp. 606-627, 13 figs. Determination of burning range of porcelain bodies having covering fired at cone 10 and above. Composition of bodies used varied from 45 to 85 per cent clay content and from 10 to 30 per cent flux.

See also METALLURGY, Iron and Steel (Tests); CIVIL ENGINEERING, Cement and Concrete.

MEASUREMENTS AND MEASURING APPARATUS

Boiler Feedwater

Measuring Boiler Feedwater, D. L. Fagnan. Nat Engr., vol. 23, no. 1, Jan. 1919, pp. 18-22, 5 figs. Discussion of various methods; principles of operation and construction of representative types. Paper before Nat. Assn. Stationary Engrs.

Calorimeters

The Calorimetry of Coal. Engineering, vol. 107, no. 2767, Jan. 10, 1919, pp. 33-36, 10 figs. A description of the calorimeter and its use.

Compressibility of Solids

The Determination of the Compressibility of Solids at High Pressures, Leason H. Adams, Erskine D. Williamson and John Johnston. Jl. Am. Chem. Soc., vol. 41, no. 1, Jan. 1919, pp. 12-42, 12 figs. Essence of method is to compare change of volume under hydrostatic pressure of a cylinder of a material and that of a similar soft-steel cylinder the compressibility of which is assumed as $0.60/10^6$ cm.^{2} per megadyne at all pressures. Results are presented for 16 materials (metals, alloys and salts) at pressures up to 12,000 megabars.

Hardness

Hardness of Soft Iron and Copper Compared, F. C. Kelley. Iron & Steel Can., vol. 1, no. 11, Dec. 1918, pp. 433-434. Tests by Brinell methods on samples of American ingot iron and ordinary commercial cold-rolled copper which were given similar treatments in an electrically heated vacuum furnace.

Instruments for Hardness Tests, C. E. Clewell. Am. Mach., vol. 50, no. 3, Jan. 16, 1919, pp. 93-96, 5 figs. Importance of hardness tests; early forms of Brinell hardness determination and recent modifications; use of scleroscope as check on pyrometer; methods suggested for holding materials under test.


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Testing Materials for Hardness. Howard Ensaw. Am. Mach., vol. 50, no. 6, Feb. 6, 1919, pp. 257-258. Describing some methods of testing materials for hardness.

Pyrometers

How to Test Pyrometer Efficiency. Iron Trade Rev., vol. 64, no. 2, Jan. 9, 1919, pp. 158-159, 5 figs. Method provides for maintenance of calibrated platinum-platinum-rhodium thermocouple and comparison of this standard with the instruments that are to be tested.

Standards of Temperature and Means for Checking Pyrometers. Proc. Steel Treating Research Soc., vol. 2, no. 1, 1919, pp. 30-37, 7 figs. Method for carrying out necessary tests and suggestions of various equipments suitable for determining inaccuracies in pyrometer readings, which, it is said, are always traceable to thermocouple, measuring instruments or lead wires.

Shearing Strength

New Machine for Measuring the Shearing Strength of Cast Iron (Nouvelle machine pour mesurer la résistance de la fonte par la méthode du cisaillement). Ch. Fremont. Génie Civil, vol. 73, no. 26, Dec. 28, 1918, p. 516, 9 figs. Also Comptes rendus des séances de l'Academie des Sciences, vol. 167, no. 24, Dec. 9, 1918, pp. 949-952, 9 figs.

Stack Heat Losses

Measurement of Stack Heat Losses, J. H. Blakey. Power Plant Eng., vol. 23, no. 3, Feb. 1, 1919, pp. 151-152, 2 figs. Electrical device embodying simplicity and accuracy for determining stack heat losses.

See also ELECTRICAL ENGINEERING, *Measurements and Tests (Thermocouples and Pyrometers)*

MECHANICAL PROCESSES

Barrels, Steel

Manufacture of Steel Barrels, Edward K. Hammond. Machy., vol. 25, no. 6, February, 1919, pp. 526-533, 19 figs. Blanking the barrel heads, bending the sheets for the bodies, welding flanging, brazing, bilging, pickling and testing.

Boiler Manufacture

How to Design and Lay Out a Boiler—III, William C. Strott. Boiler Maker, vol. 19, no. 1, Jan. 1919, pp. 10-12, 4 figs. Thickness of butt straps; rivet failures due to tearing of plate, stretching of holes or tendency to shear. (To be continued.)

Boiler Smoke Tubes

The Repair of Steel Boiler Smoke-Tubes. Ry. Gaz., vol. 29, no. 26, Dec. 27, 1918, pp. 729-731, 4 figs. Specifications to which tubes are purchased; operations in repairing of tubes removed from boiler.

Brass Extrusion

The Extrusion of Brass, Alfred Hutt. The Central (Jl. City & Guilds Eng. Col.), vol. 15, no. 44, Dec. 1918, pp. 68-77, 5 figs. Description of a brass extrusion press. By extrusion is meant process whereby a plastic substance is given a definite shape by being forced through an orifice or die under pressure. Alloy used is Muntz metal consisting of 60 per cent copper and 40 per cent zinc.

Cement Mills

Operating Details of an Electrically Operated Cement Mill. Elec. Rev., vol. 74, no. 6, Feb. 8, 1919, pp. 210-212, 4 figs. Progress of material through mill; process of cement manufacture; apparatus and size of motor utilized.

Chains, Cast-Steel

The Manufacture and Testing of Cast Steel Chain Cables. Jl. Am. Soc. Naval Engrs., vol. 30, no. 4, Nov. 1918, pp. 858-862. Memorandum issued by Lloyd's Register of Shipping. From Engineer.

Coke Manufacture

Plant of the Seaboard By-Product Coke Company, D. Mac Arthur. Gas Age, vol. 43, no. 2, Jan. 15, 1919, pp. 69-73, 9 figs. Coke-loading equipment; electrical control switchboard; light-oil extraction and refining. (Concluded.)

Cotton Compression

Economics of High Density Cotton Compression. Richard Hoadley Tingley. Textile World Jl., vol. 55, no. 2, Jan. 11, 1919, pp. 133, 191 and 381, 4 figs. Description of present compression methods; brief history of high-density movement.

Dies

Making Dies for Cutting Rubber, Leather, Paper, Cloth, etc., S. A. Hand. Am. Mach., vol. 50, no. 2, Jan. 9, 1919, pp. 52-54, 11 figs.

Kilns

The Use of Car Tunnel Kilns for Brick and Other Products of Crude Clays, Ellis Lovejoy. Jl. Am. Ceramic Soc., vol. 1, no. 9, Sept. 1918, pp. 628-634, and (discussion) pp. 634-636. Features and respective values of (1) direct heating in car-tunnel kilns, (2) indirect heating in tunnel, and (3) compartment-operation types of car-tunnel kilns.

Lubricator, Mechanical

Manufacturing a Mechanical Lubricator, M. E. Hoag. Am. Mach., vol. 50, no. 2, Jan. 9, 1919, pp. 71-74, 13 figs. (Third article.)

Machine Knives

Making Machines Knives, W. F. Sutherland. Can. Machy., vol. 21, no. 4, Jan. 23, 1919, pp. 73-77, 8 figs. Operations connected with welding and grinding of knives for wood-working tools and paper cutters.

Magnetos

The Magneto Industry. Engineer, vol. 127, no. 3289, Jan. 10, 1919, pp. 26-29, 12 figs. Description of the Thomson-Bennett Works, Birmingham.

Plate Mills

New Plate Mills with Modern Lay-Out. Blast Furnace, vol. 7, no. 1, Jan. 1919, pp. 43-47, 8 figs. Designed to give sufficient capacity of heating, finishing and shipping.

Lukens New Plate Mill Largest in the World. Boiler Maker, vol. 19, no. 1, Jan. 1919, pp. 6-10, 6 figs. Mill is of 4-high type with rolls 204 in. wide, and will roll 5000 tons of plate per week.

Pliers

The Liberty Plier; Drop-Forged Victory. Am. Drop Forger, vol. 5, no. 1, Jan. 1919, pp. 32-35. Distribution of work and sanitary dispositions at Krauter plant where 23,000,000 forgings have been completed during last 18 months.

Sugar Manufacture

Sugar Factory Engineering, C. B. Thompson and J. O. Frazier. Nat. Engr., vol. 23, no. 1, Jan. 1919, pp. 23-26, 2 figs. Problems peculiar to industry and equipment details of factory; preparation and burning of bagasse; arrangement of multiple effect.

Tin Plate

Tin Plate Manufacturing and Detinning. Engineering, vol. 106, no. 2764, Dec. 20, 1918, pp. 701-702. An historical article.

See also ELECTRICAL ENGINEERING, *Power Applications (Steel-Mill Drives)*

MECHANICS

Shafts, Whirling Speed of

The Whirling Speed of Shafts Supported in Three Bearings, Arthur Morley. Engineering, vol. 106, no. 2760, Nov. 22, 1918, pp. 573-574, 3 figs. Introduction notation; calculation from equation of energy; method of successive approximation; application of various forms of support; Dunkerley's empirical rule; Bauman's method. (To be continued.)

New Critical Shaft Speeds as Effects of the Gyroscopic Disc-Action, A. Stodola. Engineering, vol. 106, no. 2763, Dec. 13, 1918, pp. 665-666, 4 figs. Mathematical development.

Springs

A New Theory of Plate Springs, David Landau and Percy H. Parr. Jl. Franklin Inst., vol. 187, no. 1, Jan. 1919, pp. 65-97, 14 figs. Study of trapezoidal, circular, parabolic and square leaf points. It is concluded that tapering points of leaves of leaf springs in plane of width only has no practical effect on strengths, reactions, stresses, or flexibilities of springs. Calculations of stresses, bending moments and deflections. Separation of loads in the top compound plate.

A Theory of Plate Springs, David Landau and Percy H. Parr. Jl. Soc. Automotive Engrs., vol. 4, no. 2, Feb. 1919, pp. 67-72, 9 figs. Based on assumption that any leaf of a spring can be considered as a beam, encastré at one end, loaded at the other, and having a flexible support somewhere between the point of encastrement and that of application of the load. (To be continued.) From Jl. Franklin Inst.

Wires, Tension in

Rapid Determination of the Tension in Stretched Electric Wires (Récherche rapide de la tension à laquelle travaille le metal dans les canalisations électriques sous l'action de l'effort de traction), Jean Hely. Revue Générale de l'Electricité, vol. 5, no. 1, Jan. 4, 1919, pp. 26-27, 1 fig. Chart constructed on physical law of vibration of chords. Tension determined from number of transversal vibration of a known length.

MOTOR-CAR ENGINEERING

Air Cleaners

Carbureter Air Cleaners, W. G. Clark. Jl. Soc. Automotive Engrs., vol. 4, no. 1, Jan. 1919, pp. 18-22 and (discussion) pp. 22-23, 14 figs. Classification and description of four types: cleaners having cloths or screens or both, inertia cleaners, those in which water or some other liquid is used to wash air, and centrifugal or gravity cleaners.

Design

1919 Engineering Trends, H. Ludlow Clayden. Automotive Industries, vol. 40, no. 3, Jan. 16, 1919, pp. 88-89, 94-97 and 157, 11 figs. Graphs showing increase of crankshaft revolutions per mile, increase in stroke-bore ratio, tendencies in drive of accessories, comparative percentages of disk and cone clutches, use of vacuum gasoline feed, use of spiral bevel drive and changes in lubricating systems.

Trucks Show Few Mechanical Changes. Automotive Industries, vol. 40, no. 3, Jan. 16, 1919, pp. 110-111, 4 figs. Claims that war activites have retarded mechanical development in commercial vehicle design and that curtailment of supplies of raw material has reduced production originally planned.

Automotive Industry Achievements in 1918. Am. Drop Forger, vol. 5, no. 1, Jan. 1919, pp. 44-48, 2 figs. Development in tractor, truck, trailer and aeroplane manufacture; relation of drop-forging industry to automotive-engine evolution.

Fuels

Benzol as a Motor Fuel, S. E. Whitehead. Gas Jl., vol. 144, no. 2901, Dec. 17, 1918, pp. 615-616. Remarks that a Motor Union Committee in 1907 reported they had successfully used benzol, either alone or in combination with petrol, as motor fuel. It then takes up more in detail properties of benzol and its intrinsic adaptability as motor fuel.

The Motor Fuel Problem, W. R. Ormandy. Petroleum Rev., vol. 39, nos. 853, 854 and 855, Nov. 23 and 30, Dec. 7, 1918, pp. 335-336, 355-356 and 363. Demand and supply of motor fuels in British Empire. Solid gaseous and liquid fuels are considered separately.

Headlights

The Requirements of Automobile Headlights. Illum. Engr., vol. 11, no. 9, Sept. 1918, pp. 209-211. Report of a committee on the Illum. Eng. Soc.

Horns

Electrical and Mechanical Warning Signals for Automobiles, Fred I. Hofman. Automotive Industries, vol. 40, no. 2, Jan. 9, 1919, pp. 47-50, 21 figs. Principles involved in operation of diaphragm signals; relative advantages of electric motor horn, electric vibrator horn and hand-operated horn; variety in mechanism of hand horns.

Kerosene Engines

Bellem-Brégéras Method of Using Refined Petroleum and Heavy Oils in Low-Compression Oil Engines (Emploi du pétrole lampant et des huiles lourdes dans les moteurs à explosion à basse compression. Procédés Bellem et Brégéras. Génie Civil, vol. 73, no. 22, Nov. 30, 1918, pp. 433-435, 3 figs. Description of machine which obtained 50,000-franc prize offered by the Chambre Syndicate des Industries du Pétrole for best automobile petroleum engine. Account of tests also given.

Locking Devices

Automobile Locking Devices. Jl. Soc. Automotive Engrs., vol. 4, no. 2, Feb. 1919, pp. 97-98, 1 fig. Results of study of automobile locking devices by committee of Soc. Automobile Engrs.

Lubrication

Lubrication and Fuel Tests on Buda Tractor Type Engine, P. J. Dasey. Jl. Soc. Automotive Engrs., vol. 4, no. 1, Jan. 1919, pp. 50-53, 5 figs. Horsepower developed at different speeds by four fuels; power developed per lb. of fuel, fuel consumption in lb. per b-hp. hr.

Production

Future Production Plans Will Require Special Machinery, J. Edward Schipper. Automotive Industries, vol. 40, no. 3, Jan. 16, 1919, pp. 145-149, 13 figs. Description of certain machines which permit production on large scale and forecast of developments on jigs, tools, gases, etc., necessary to fit into efficient production scheme.

Spark Plugs

Effect of Temperature on Spark Plug Insulations. Automotive Industries, vol. 40, no. 1, Jan. 2, 1919, p. 25, 1 fig. Experiments carried out in England show that minimum permissible insulation resistance varies with frequency of sparks and compression pressure.

Statistics

Truck Production for 1918 Is 250,000. Automotive Industries, vol. 40, no. 3, Jan. 16,

HUNT MACHINERY
for
Economically Handling Bulk Material and Manufactured Products
"Industrial" Railways
Electric Industrial Trucks & Trailers
Cut off Gates or Valves
Cable Railways
"Stevedore" Transmission & Hoisting Rope
Coal Tubs. Contractors Tubs
Coal Crackers
LOADING CAR
Pivoted Bucket Conveyors
Skip Hoists
Automatic Railways
Storage Battery Locomotives
Trolley Locomotives & Cars
Grab Buckets
Scales – Track & Suspended
"SQUAT" TYPE CUT OFF GATE-OPEN
47 YEARS AGO
In 1872 the Automatic Railway, the first real improvement over the time-worn "Hand" method of handling coal, was invented by Charles W. Hunt.
Since that time the Company he founded, and which bears his name, has developed many other UNIQUE LABOR SAVING AND LABOR AIDING DEVICES for storing and transferring coal, ashes, ore, sand, gravel, fertilizer and other bulk materials, as well as manufactured packaged products.
The list above indicates the scope of the Hunt Line, and our Engineers will be glad to confer with those interested in this subject—
SAVING IN HANDLING MATERIAL
C. W. HUNT COMPANY, Inc.
501 Fifth Avenue, New York, N. Y.
"SQUAT" TYPE CUT OFF GATE-CLOSED
PIVOTED BUCKET CONVEYOR HORIZONTAL RUN
STORAGE BATTERY TRUCKS-PANAMA CANAL
32 OF THE 60 HUNT ELECTRIC TRUCKS AT PANAMA CANAL
PIVOTED BUCKET CONVEYOR AND FILLER
CHARGING STOKERS
HUNT TRUCKS HANDLING MISCELLANEOUS FREIGHT-SEATTLE
CABLE RAILWAY-SHOWING CURVE ARRANGEMENT
COAL CRACKER-ARRANGED FOR BELT DRIVE
BALANCED "SKIP HOIST" AND AUTOMATIC RAILWAY
INDUSTRIAL RAILWAY-3 TYPES HUNT CARS
HUNT
MOTOR CARS TROLLEY OR THIRD RAIL

1919, pp. 128-129, 1 fig. Gain of 32 per cent over 1917. Proportion of trucks of each regular capacity shown diagramatically.

Tanks

U. S. A. Two-Man Tank Fitted with Motor Car Engines. Motor Age, vol. 35, no. 2, Jan. 9, 1919, pp. 16-18, 6 figs. Automotive Industries, vol. 40, no. 2, Jan. 9, 1919, pp. 43-46, 6 figs. Motor Age: Adaptation of standard units in construction of Ford tank. Automotive Industries: Two-man fighting machine having a duplicate Ford automobile power plant, radiator mounted at rear, worm drive.

U. S. Tank and Tractor Details. Motor Age, vol. 34, no. 26, Dec. 26, 1918, pp. 20-21, 4 figs. Cargo carrier Mark VII; Ford tank.

Tractors, Specifications for

Detailed Technical Specifications of Gasoline Farm Tractors for 1919. Automotive Industries, vol. 40, no. 3, Jan. 16, 1919, pp. 176-179. Tabulated data on 98 different makes of American types produced by 69 manufacturers with makes of principal parts, including engine, governor, lubricator, ignition system, air cleaner, gear set, clutch and axle.

Trucks, Specifications for

Detailed Technical Specifications of Gasoline Motor Trucks for 1919. Automotive Industries, vol. 40, no. 3, Jan. 16, 1919, pp. 112-127. Full particulars on types and makes of principal truck parts, including engines, clutches, gear sets, rear axles, steering gears, governors and electric and fuel sytems; 489 gasoline, 19 electric and one steam motor-truck chassis described.

Water Injection

Mixing Water with Gasoline. Motor Boating, vol. 23, no. 1, Jan. 1919, 25-26, 9 figs. Advantages gained by introducing limited quantities of water into intake manifold. Its use as a decarbonizing medium.

See also MINING ENGINEERING, Oil and Gas (Gasoline); MECHANICAL ENGINEERING, Mechanical Processes (Magnetos); Standards and Standardization.

PIPE

Electrolysis

Fuel Administration Interests Itself in Electrolysis in Natural Gas Mains, Frank H. West. Am. Gas Eng. Jl., vol. 110, no. 2, Jan. 11, 1919, pp. 22-23. Electrolytic action made patent by pipes taken from streets of Kansas City. Claimed that damage by electrolysis amounts to millions annually in U. S.

Reinforced-Concrete Pipe

On the Reinforced-Concerte Pressure Pipe (in Japanese), N. Sugimura. Denki Gakkwai Zasshi, no. 365, Dec. 10, 1918.

Reinforced Concrete Pressure Pipe, Coleman Merriwether. Jl. Am. Water Works Assn., vol. 5, no. 4, Dec. 1918, pp. 419-429, 2 figs.; Water and Gas Rev., vol. 29, no. 7, Jan. 1919, pp. 11-12, 2 figs.; Can. Engr., vol. 36, no. 3, Jan. 16, pp. 146-148, 2 figs. Jl. Am. Water Works Assn.: Details of joint with crimped copper band. Water and Gas Rev.: Action of joint constructed with crimped copper band, details of manufacturing 66-in. reinforced-concrete pressure pipe for 10 miles of Greater Winnipeg water conduit. Can. Engr.: Installation of plant for manufacturing 66-in. reinforced-concrete pressure pipe, details of manufacture, lead gasket cast-iron joint. Paper before Ill. Section, Am. Water Works Assn.

Templates and Patterns

Templates and Patterns for Pipes, James Edgar, Brass World, vol. 14, no. 10, Oct. 1918, pp. 291-294, 34 figs. On construction of templates and patterns for special connections, especially in shipbuilding industry.

See also CIVIL ENGINEERING, Water Supply (Pipe Maintenance)

POWER GENERATION

Appalachians

New Plant of the Appalachian Power Company, H. S. Slocum. Elec. World, vol. 73, no. 3, Jan. 18, 1919, pp. 123-127, 9 figs. Steam station rated at 20,000 kw. just completed to supplement hydroelectric plants in meeting heavy industrial demands; development of rich mining district due largely to central-station power supply.

Canada

Electric Power Generation in Ontario on Systems of Hydoelectric Power Commission, Arthur H. Hull. Proc. Am. Inst. Elec. Engrs., vol. 38, no. 1, Jan. 1919, pp. 29-52, 16 figs. Systems of Hyroelectric Power Commission of Ontario.

Canada Builds 300,000 Hp. Niagara Hydro Plant, Louis B. Black. Mine & Quarry, vol. 11, no. 1, Nov. 1918, pp. 1097-1104, 8 figs. Hydro Electric Power Comm[illegible]n of Ontario is engaged upon construction of a canal 8½ miles long, which will divert a flow of 10,000 sec.-ft. of water from Niagara F[illegible]ls and enable 300,000 hp. to be developed.

Centralization

Central Station Power for Mines, A. Tancig. Bul. Affiliated Eng. Societies Minn., vol. 3, no. 12, Dec. 1918, pp. 205-207. Advantages to each mine of centralized power generation.

Transportation and Power, C. G. Gilbert and J. E. Pogue. Can. Engr., vol. 36, no. 2, Jan. 9, 1919, pp. 128-130. Advantages and disadvantages of centralization of power stations and generation of electrical energy in bulk. Excerpt from report to Smithsonian Instn. on Power: Its Significance and Needs.

Centralizing Power Production. Power Plant Eng., vol. 23, no. 2, Jan. 15, 1919, pp. 99-104, 9 figs. Operation of dual driven auxiliaries, induced draft and modern coal and ash handling equipment features of Cromby Station of Philadelphia Suburban Gas & Electric Co.

Eastern States

Development of Hydroelectric Resources in Eastern United States, D. H. Colcord. Elec. Rev., vol. 74, no. 6, Feb. 8, 1919, pp. 207-209, 4 figs. Deterring influences and development outlined; brief review of what has been accomplished; urgent needs and benefits of hydroelectric developments.

Glaciers

Power from Glaciers. Electric Traction, vol. 15, no. 1, Jan. 15, 1919, pp. 1-4, 9 figs. Addition to White River Power Plants of Puget Sound Traction Light & Power Co. for electrification of Milwaukee Ry.

Hetch Hetchy

The Power Project at Hetch Hetchy, Rudolph W. Van Norden. Jl. Elec., vol. 42, no. 2, Jan. 15, 1919, pp. 65-66, 2 figs. Gives details of 66,000-hp. development at Moccasin Creek, a part of project planned by city of San Francisco.

Maine

Investigation of Maine Water Powers. Elec. World, vol. 73, no. 3, Jan. 18, 1919, pp. 120-121, 1 map. Public Utilities Commission sends to governor and council results of an exhaustive study of water-power resources; hydroelectric systems, power sites, plant locations and storage conditions dwelt on.

Massachusetts

Development of Massachusetts' Water Power. Elec. World, vol. 73, no. 6, Feb. 8, 1919, pp. 272-273, 1 map. From the report of a special commission to investigate the facilities and possibilities in this direction; Action urged; public ownership declared to be of doubtful value as a water-power policy.

Michigan

Simplicity Marks Michigan's Largest Hydroelectric Development. Elec. Rev., vol. 74, no. 5, Feb. 1, 1919, pp. 167-170, 6 figs. Simplicity of layout, coordination of turbines installed to water flow and 140,000 volt transmission line are features of the Junction Development.

Pacific Coast

Water-Power Development on the Pacific Coast, George F. Sever. Elec. World, vol. 73, no. 4, Jan. 25, 1919, pp. 177-178; Jl. Elec., vol. 42, no. 1, Jan. 1, 1919, pp. 6-10. Elec. World: Study of economic and financial conditions leads to outline of developments approximating $50,000,000 cost, all power furnished can be absorbed easily within two years after development. Jl. Elec.: Survey of projects in progress of construction in California, rules of Forest Service in their relation to hydroelectric development. From paper before San Francisco Association of Members of Am. Soc. C.E.

Tennessee

The Larger Undeveloped Water-Powers of Tennessee, J. A. Switzer. Gen. Meeting Am. Electrochem. Soc., Apr. 30, 1918, paper 24, pp. 169-202, 15 figs. Power sites and essential data pertaining to their development and exploitation.

Tides

Utilization of Power from Tides (Etude sur l'utilisation des marées pour la production de la force motrice), E. Maynard. Revue Générale de l'Electricité, vol. 4, nos. 22, 23, 24, 25 and 26, Nov. 30, Dec. 7, 14, 21 and 28, 1918, pp. 823-843, 865-877, 903-914, 947-959 and 997-1007, 34 figs. Nov. 30: Derivation of continuous power from tide basins and sea reaches; application of system to St. Malo and La Rochelle regions. Dec. 7: Continuous power of operation at set intervals after high and low tides; application to St. Malo and La Rochelle. Dec. 14: System comprising two basins to utilize ebb and flow currents respectively so as to produce continuous work; application of plan to St. Malo and La Rochelle. Dec. 21: Application of processes described in previous articles to Rotheneuf Bay, near St. Malo (Ille-et-Vilaine), and Bay of La Rochelle. Dec. 28: Possibilities at mouth of La Rance river in 21-km. region where action of tides is felt.

POWER PLANTS

Boiler Corrosion

Action of Water on Metals, S. W. Parr. Can. Engr., vol. 36, no. 3, Jan. 16, 1919, p. 148. Reactions involved when alkaline waters are used in steam generators. Paper before Ill. Section, Am. Water Works Assn.

Boiler Operation

Safety and Economy in the Boiler Room, W. E. Snyder. Iron Age, vol. 103, no. 5, Jan. 30, 1919, pp. 306-307. Practical suggestions for reducing hazards and increasing efficiency; thorough inspection and careful training of men required. From a paper before the Engineers' Society of Western Pennsylvania.

The Chemical and Physical Control of Boiler Operation, E. A. Uehling. Mech. Eng., vol. 41, no. 2, Feb. 1919, pp. 137-141 and 199, 1 fig. Formulæ for calculating heat losses in chimney gases and their application to data derived from autographic records of CO_2.

Boiler Settings

Combustion and Boiler Settings, A. D. Williams. Power, vol. 49, nos. 2 and 6, Jan. 14 and Feb. 11, 1919, pp. 57-59 and 205-208, 2 figs. Jan. 14: Notes on location of heating surfaces, placing of baffles, and formation of soot in relation to combustion. Feb. 11: Effect produced on combustion reactions and circulation of gases by the chilling due to contact with water-cooled surfaces.

Drip Water

Saving and Returning Drip Water, William E. Dixon. Power Plant Eng., vol. 23, no. 2, Jan. 15, 1919, pp. 105-109, 9 figs. Where drip taps should be made; methods employed for returning condensate; utilizing oily drips.

Economizers

Care of Economizers, J. F. Daggett. Power, vol. 49, no. 6, Feb. 11, 1919, pp. 192-193, 4 figs. Some suggestions as to the operation and care of economizers.

Equipment

Power Station at Mark Plant, Gordon Fox. Power Plant Eng., vol. 23, no. 3, Feb. 1, 1919, pp. 141-144, 4 figs. Describes power plant of the Sheet Tube Company of America, dealing with turbine generators and blower, condensing system and electric features. Second article.

Exhaust Steam

Utilizing Exhaust Steam in Knitting Mill, L. H. Stark. Nat. Engr., vol. 23, no. 1, Jan. 1919, pp. 2-6, 5 figs. How savings were effected by several changes in equipment and use of indicating and recording devices.

Firebox

Boiler Efficiency Increased by New Type of Firebox. Ry. Age, vol. 66, no. 2, Jan. 10, 1919, pp. 151-153, 2 figs. Eighteen per cent greater evaporation per pound of coal secured in tests on C., M. & St. P.

Hand-Fired Plants

Fuel Economy in Hand-Fired Power Plants. Power Plant Eng., vol. 23, no. 2, Jan. 15, 1919, pp. 110-113, 4 figs. Fifth installment of abstract of Circular No. 7, Univ. of Ill., Eng. Experiment Station.

Low-Grade Fuels

Peace Problems in the Power Plant, George H. Perkins and Perry Barker. Textile World Jl., vol. 55, no. 2, Jan. 11, 1919, pp. 391-392. Importance of continuing war economics; difficulties in use of low-grade fuels.

Operation

Turbine House Plant Operation, T. G. Otley and V. Pickles. Elecn., vol. 82, no. 2120, Jan. 3, 1919, pp. 4-6. Abstract of a paper read before the South African Institute of Electrical Engineers.

Stokers

Power Plant Management—VII. Mechanical Stokers, Robert June. Refrig. World, vol. 54, no. 1, Jan. 1919, pp. 25-26, 2 figs. Adaptability of various types of stokers according to ratings of boilers; points to remember regarding stoker operation.

Automatic Cleaning Under-Feed Stoker Nat. Engr., vol. 23, no. 1, Jan. 1919, pp. 100-102, 4 figs. Type developed by Under-Feed Stoker Co. is similar to standard Jones stoker but is self-cleaning.

See also RAILROAD ENGINEERING, Locomotives (Thermic Siphons); MARINE ENGINEERING, Auxiliary Equipment (Valves and Fittings)

PRODUCER GAS

German Producers

New Coke-Fired German Gas Producer. Iron Age, vol. 103, no. 3, Jan. 16, 1919, pp. 180-181, 1 fig. Makes gas low in moisture and sulphur; pig iron high in manganese and phosphorus a by-product.

Producer-Gas Users

Modern Applications of Producer Gas, Earl E. Adams. Am. Drop Forger, vol. 5, no. 1, Jan. 1919, pp. 41-44, 2 figs. Its use in heat-treating and carbonizing furnaces; economy and general advantages.

Wuerth Producer

The Wuerth Gas Producer. Foundry Trade Jl., vol. 20, no. 203, Nov. 1918, pp. 600-601, 1 fig. Features of apparatus which is worked on blast-furnace principle and consists of a hearth without grating, a bosh and a shaft. From Stahl und Eisen.

PUMPS

Centrifugal Pumps

High-Lift Centrifugal Pumps for Irrigation, B. P. Fleming. Power, vol. 49, no. 4, Jan. 28, 1919, pp. 133-136, 3 figs. Water forced through steel manifold to reinforced-concrete conduit leading up to canal; design features; pump tests show over 81 per cent efficiency under 90-ft. head.

Pump Station

A Non-Drowning Pump-Station, C. Erb Wuench. Min. & Sci. Press, vol. 118, no. 1, Jan. 4, 1919, p. 18, 1 fig. Design utilizing principle of hydraulic diving bell.

Vacuum Pumps

Automatic Variation of Gas Pressure and Its Application to a Vacuum Pump, Circulation of Gases, Magnetic Stirrer, O. Maas. Jl. Am. Chem. Soc., vol. 41, no. 1, Jan. 1919, pp. 53-59, 3 figs. Control apparatus by means of which pressure established by a Geissler, or any other suction pump, can be automatically varied between definite limits and the period of each variation can be adjusted to any desired length of time.

REFRACTORIES

Corrosion

Report on the "Corrosion Action of Flue Dust on Fire-Bricks," J. W. Mellor. Gas. Jl., vol. 144, no. 2897, Nov. 19, 1918, pp. 421-423. Experimental research by refractory materials committee of Instn. Gas Engrs.

Crushing Resistance

Crushing Resistances of Refractory Materials (Mesure des résistances à l'écrasement des matériaux réfractaires), A. Bigot. Chimie & Industrie, vol. 1, no. 7, Dec. 1, 1918, pp. 724-726, 7 figs. Gives results of experiments on 1-in. cubes of silica brick, refractory argil, white bauxite, carborundum, etc., in charts.

Production

Our Present Knowledge Concerning the Industry of Refractory Products (Nos connaissances actuelles sur l'industrie des produits refractaires), J. Bied. Chimie & Industrie, vol. 1, no. 6, Nov. 1918, pp. 579-600, 23 figs. Invention of processes for utilizing dolomitic clinkers; calcination of magnesia from Eubée and Italy; manufacture of bricks; high-temperature resistance of silica-aluminum products.

Silica Products

Silica Products (Les produits de silica). Chimie & Industrie, vol. 1, no. 7, Dec 1, 1918, pp. 712-723, 7 figs. Chemical and physical analyses of siliceous rocks; photomicrographs of bricks manufactured in Martin furnaces.

South Wales

The Refractory Materials of South Wales, J. Allen Howe. Quarry, vol. 24, no. 263, Jan. 1919, pp. 11-15. Geological characters of carboniferous strata from which are obtained silica rocks, fireclays and dolomitic limestones. Paper before Refractories Section of Ceramic Soc.

Tests

Standard Tests for Refractory Materials. Quarry, vol. 24, no. 263, Jan. 1919, pp. 19-20. Chemical analysis of fireclays, dolomite and magnesite; identification of various forms of silica in silica bricks; physical tests. Report of Committee on Standardization of Tests for Refractory Materials, Refractories Section, Ceramic Soc.

Zirconia

Zirconia — Its Possibilities in Metallurgy, Leopold Bradford. Foundry Trade Jl., vol. 20, no. 203, Nov. 1918, pp. 596-597. History, occurrence, composition and uses; its application in refractory brick industry.

REFRIGERATION

Ammonia Compressors

The Ammonia Compression Refrigerating System—XXVI, W. S. Doan. Refrig. World, vol. 54, no. 1, Jan. 1919, pp. 33-34, 2 figs. Remarks on oil-cup scheme for external lubrication of open-type ammonia compressors.

Capacity and Power Consumption of Ammonia Compressors, Charles H. Herter. Refrig. World, vol. 54, no. 1, Jan. 1919, pp. 11-13, 1 fig. Graphs for the varying capacity and power consumption of compressors, at different pressures, compared to 20 lb. and 185 lb. as standard pressures.

Ammonia Condensers

Ammonia Condenser Data, Henry Torrance. Power, vol. 49, no. 3, Jan. 21, 1919, pp. 106-109, 6 figs. Author shows that both flooded atmospheric and flooded injector types of condensers are wrong in theory and practice. From July Jl. of Am. Soc. Refrig. Engrs.

Ammonia Recovery

Effects of Ammonia Recovery, T. B. Smith. Gas. Jl., vol. 144, no. 2902, Dec. 24, 1918, pp. 661-662. Comparison of the effects of the direct and the indirect processes upon the working of other parts of plant.

Export Business

The Trend of the Foreign Situation, L. W. Alwyn-Schmidt. Refrig. World, vol. 54, no. 1, Jan. 1919, pp. 21-22 and 32. Hints to refrigerating-machine manufacturers as to future of export business and necessity for immediate action.

Freezing Tanks

Care and Maintenance of Freezing Tanks, F. L. Brewer. Ice and Refrigeration, vol. 56, no. 1, Jan. 1919, pp. 41-42. How to lower cost of freezing tank; erecting and insulating tank; causes of leakage in sides and corners. Paper before Nat. Assn. Practical Refrig. Engrs.

History

The Growth and History of Refrigeration, James F. Patton. Power House, vol. 11, no. 12, Dec. 1918, pp. 351-353, 5 figs. Dependence of cities, battleships and armies in field on refrigerating plant.

Ice Plants

Building Ice Plant Efficiency, G. B. Bright. Ice & Refrig., vol. 56, no. 1, Jan. 1919, pp. 55-56. Tonnage and cost of manufacturing ice, 1904, 1908, 1918; changes necessary in steam plants to meet new conditions.

Large Converted Steam-Driven Ice Plant. Ice & Refrig., vol. 56, no. 1, Jan. 1919, pp. 63-65. Steam plant replaced by electric-power air-agitating system; cost.

Packing Industry

Refrigeration in the Packing House Industry. Refrig. World, vol. 54, no. 1, Jan. 1919, pp. 14-16, 5 figs. Recent improvement and additions to equipment made at plant of Armour Co., Hamilton, Can.

Meat Packing in South America. Refrig. World, vol. 54, no. 1, Jan. 1919, pp. 23-24 and 32. Data and comparisons of requirements and capacity of meat-packing and freezing plants of various companies in Argentina, Brazil, Paraguay, Uruguay and Columbia.

See also INDUSTRIAL TECHNOLOGY, Ammonia.

RESEARCH

Chemical Research

Address by Charles Frederick Juritz. South African Jl. Sci., vol. 15, no. 1, Aug. 1918, pp. 1-30. Exhortation to establish chemical research stations. Position of science in the present age; its use and abuse; its part in the war; industrial potentialities in advancement of chemistry. Presidential address before South African Assn. for Advancement of Sci.

Industrial Research

Science and Industry, J. C. Fields. Can. Engr., vol. 36, no. 2, Jan. 9, 1919, pp. 133-135. What Britain, United States, France and Japan are doing in industrial research. Results being obtained by manufacturers.

Switzerland

Organization for Public Welfare in Switzerland Based on Scientific Research at the Federal University. (Stiftung zur Foerderung Schweizerischer Volkswirtschaft durch Wissenschaftliche Forschung an der Eidgenoessischen Hochschule), Schweizerische Bauzeitung, Zurich, vol. 73, no. 1, Jan. 4, 1919, pp. 1-2. Swiss engineers are raising a fund of at least 500,000 francs with which to conduct researches of the Federal University with the object of assisting Switzerland to practice greater economy and efficiency in national life than in the past, and to help the country in overcoming the losses suffered during the war. The present article describes the organization and its constitution.

STANDARDS AND STANDARDIZATION

S. A. E. Standards

S. A. E. Standardization Work in 1918. Automotive Industries, vol. 40, no. 3, Jan. 16, 1919, pp. 158-171, 31 figs. Tables of new standards put on record, mainly relating to aeronautical, motorcycle and marine work.

Tires for Motor Cars

New Standard List of Pneumatic Tire Sizes. Automotive Industries, vol. 40, no. 3, Jan. 16, 1919, pp. 172-174, 21 figs. Collection of recently adopted S. A. E. standards and recommended practices relating to tires and rims.

STEAM ENGINEERING

Boilers

Espujols Inexplosible and Demountable Boiler (Générateur de vapeur inexplosible démontable, système d'Espujols. Génie Civil, vol. 73, no. 23, Dec. 7, 1918, p. 455, 2 figs. Inclination of tubes and other arrangements contribute to facilitate active circulation of water and steam, thus protecting boiler and increasing its efficiency.

Feeding and Circulating the Water in Steam Boilers, John Watson. Jl. Am. Soc. Naval Engrs., vol. 30, no. 4, Nov. 1918, pp. 834-838, 3 figs. Review of adaptation of various appliances. Abstract of paper before Inst. Marine Engineers. From Shipbuilding Shipping Rec.

The Waste Heat Boiler as Practical Steps in Fuel Conservation, H. D. Baylor. Concrete, Cement Mill Section, vol. 14, no. 1, Jan. 1919, pp. 5-6, 1 fig. Comparative data taken on two cement kilns 10 x 150 ft., dry process, using coal as fuel, before and after installation of waste-heat boilers. Paper presented before Portland Cement Assn.

Condensers

The Steam Condenser, Victor J. Azbe. Power Plant Eng., vol. 23, no. 3, Feb. 1, 1919, pp. 145-158, 4 figs. Gain by condensing, influencing conditions, cleaning tubes, cooling water systems.

Superheat

Determination of Superheating Surface, C. H. Baker. Power, vol. 49, no. 3, Jan. 21, 1919, pp. 86-89, 4 figs. Author gives charts showing relationship between superheat and factors that influence it.

Turbine Governors

Steam Turbine Governors, J. Humphreys. Iron & Coal Trades Rev., vol. 97, no. 2650, Dec. 13, 1918, pp. 661-662, 5 figs. Discussion of several types.

Turbines

2500-Hp. Rateau Marine Geared Turbines. Jl. Am. Soc. Naval Engrs., vol. 30, no. 4, Nov. 1918, pp. 842-849, 8 figs. Arrangement of 2500-shaft-hp. turbine set and double-reduction gearing at works of British Westinghouse Co. From Engineer.

A New Theory of the Steam Turbine, Harold Medway Martin. Mechanical Engineering, vol. 41, no. 2, Feb. 1919, pp. 150-154, 3 figs. Theory is based on assumption that steam is never in thermal equilibrium until condenser is attained. Abstract of serial in Engineering.

Steam Leakage in Dummies of the Lungstrom Type. Engineering, vol. 107, no. 2766, Jan. 3, 1919, pp. 1-3, 2 figs. Comparison of the results obtained by the use of a formula with step by step calculations of the discharge through a labyrinth using the precise formula given by Professor Callendar.

Steam Turbine Progress and Possibilities. Am. Drop Forger, vol. 4, no. 12, Dec. 1918, pp. 495-497, 5 figs. Higher boiler pressures. Intermediate steam reheating in large multiple-cylinder machines. Feedwater heating. Economy to be expected from extended use of economizer.

Historical Development of the Steam Turbine—II. Power House, vol. 11, no. 12, Dec. 1918, pp. 346-349, 12 figs. Growth in size of turbo-generator units in recent years.

Operation of Steam Turbines, J. Humphreys. Iron & Coal Trades Rev., vol. 97, no. 2642. Oct. 18, 1918, pp. 430-432, 4 figs. Deals with Parsons turbine.

Land and Marine Steam Turbines. Engineering, vol. 106, no. 27ye, Dec. 13, 1918, pp. 674-675, 13 figs. Illustrations of details and brief description of steam turbines constructed by the Atlas Engineering Co., Copenhagen.

45,000 kw. Cross-Compound Steam Turbine. Elec. News, vol. 27, no. 24, Dec. 15, 1918, pp. 24-27, 4 figs. Unit consists of separate high- and low-pressure elements, each coupled directly to its own generator. High pressure

element is a single-flow, reaction-type turbine running at 1800 r.p.m. and expanding to atmosphere; low-pressure element is a double-flow turbine of same type, running at 1200 r.p.m. and expanding to vacuum.

TEXTILES

Fabric Looms

An Apparent Revolution in Fabric Looms. Flight, Dec. 26, 1918, pp. 1463-1464, 4 figs. New Trautvetter loom claimed to weave (auto and aero fabric) diagonal threads in two directions as well as ordinary warp and weft.

THERMODYNAMICS

Heat Transmission

The Transmission of Heat Through Heavy Building Materials. Engineering, vol. 106, no. 2765, Dec. 27, 1918, pp. 735. From bulletin issued from University of London, University College, Department of Heating and Ventilating Engineering, entitled Report of Research on Transmission of Heat Through Heavy Building Materials, by Arthur H. Barker and M. Kinoshita.

WELDING

Arc Welding

Electric Arc Welding in Tank Construction, R. E. Wagner. Gen. Elec. Rev., vol. 21, no. 12, Dec. 1918, pp. 899-911, 35 figs. Practice followed at Pittsfield works of General Electric Co.

A Review of Electric Arc Welding, John A. Seede. Gen. Elec. Rev., vol. 21, no. 12, Dec. 1918, pp. 881-886, 11 figs. Evolution of present practice of arc welding.

Equipment Accessories Desirable in Electric Arc Welding. Elec. Ry. Jl., vol. 53, no. 2, Jan. 11, 1919, pp. 93-95, 6 figs. Proper protection of operator is essential and conveniences added insure better workmanship. From 1918 report of committee of Assn. of Ry. Elec. Engrs.

Notes on Regulations for Arc Welding, H. M. Sayers. Elecn., vol. 81, no. 2118, Dec. 20, 1918, pp. 715-717. Abstract of paper with discussion before the Institution of Electrical Engineers, Dec. 1918.

Arc-Welding Systems, Otis Allen Kenyon. Elec. Wld., vol. 73, no. 4, Jan. 25, 1919, pp. 167-171, 10 figs. Welding system discussed in a broad way, showing advantages and special usefulness of each method.

Cutting of Metals

The Cutting of Iron and Steel by Oxygen—XX, M. R. Amedeo. Acetylene & Welding Jl., vol. 15, no. 182, Nov. 1918, pp. 199-200. Cost of cutting. Translated by a member of the Union de la Soudure Autogene.

Inspection

Inspection of Metallic Electrode Arc Welds, O. S. Escholz. Am. Mach., vol. 50, no. 5, Jan. 30, 1919, pp. 215-217, 6 figs. Outlines the methods for satisfactory inspection tests.

Determining the Characteristics of Metallic-Electrode Arc Welds, O. S. Escholz. Elec. Ry. Jl., vol. 53, no. 6, Feb. 8, 1919, pp. 280-282, 3 figs. By testing and inspection of the welds a reliable indication of their soundness may be obtained.

Lead

The Autogenous Welding of Lead, V. P. Rosenberg. Acetylene & Welding Jl., vol. 15, no. 182, Nov. 1918, pp. 205-206, 2 figs. Power of blowpipe. (To be continued.)

Lloyd's Tests

Lloyd's Experiments on Electrically Welded Joints, H. Jasper Cox. Gen. Elec. Rev., vol. 21, no. 12, Dec. 1918, pp. 864-870, 15 figs. Nature and description of experiments; summary of experimental results.

Oxy-Acetylene

The Oxy-Acetylene Flame and Blowpipe Efficiency, Arthur Stephenson. Acetylene & Welding Jl., vol. 15, no. 182, Nov. 1918, pp. 194-196, and (discussion) pp. 196-198, 5 figs. Diagram giving length of luminous cone in mm. for respective consumption of acetylene in litres per hour; graph showing diversity in acetylene consumption as specified by various makers for welding iron and steel; blowpipe movements. Paper before British Acetylene & Welding Assn. Also abstracted in Jl. Acetylene Welding, vol. 2, no. 7, Jan. 1919, pp. 338-344.

Rail Joints

New Type of Electrically Welded Joint Successful. Elec. Ry. Jl., vol. 53, no. 4, Jan. 25, 1919, pp. 182-183, 8 figs. Process used at St. Louis believed to eliminate cracking of rail around joint; applicable to new and old track.

Railroad Shops

Oxy-Acetylene and Electric Welding, A. F. Dyer. Welding Engr., vol. 4, no. 1, Jan. 1919, pp. 45-46. Application of these processes at Grand Trunk railway shops.

Spot Welding

Research in Spot Welding of Heavy Plates, W. L. Merrill. Gen. Elec. Rev., vol. 21, no. 12, Dec. 1918, pp. 919-922, 7 figs. Experiments pointing to new and enlarged field for spot welding.

Spot Welding and Some of Its Applications to Ship Construction, H. A. Winne. Gen. Elec. Rev., vol. 21, no. 12, Dec. 1918, pp. 923-927, 6 figs. Advantages of spot welding over riveting with respect to strength, time and labor; limitations of spot welding.

Thermit

Modern Welding and Cutting, Ethan Viall. Am. Mach., vol. 50, no. 6, Feb. 6, 1919, pp. 243-248, 6 figs. Thermit welding: its history, nature and uses. First article.

See also RAILROAD ENGINEERING, Shops (Welding); MARINE ENGINEERING, Ships (Welded Ships); Yards (Welding)

VARIA

Inspection and Theory of Probability

Application of the Theory of Probability to the Matter of Inspection (Sull' applicazione del calcolo delle probabilita ad una importante categoria di collaudi), U. Bordoni, L'Elettrotecnica, vol. 5, no. 30, Oct. 25, 1918, pp. 422-430, 8 figs. Mathematical analysis of the problem: what can be asserted of the properties of a number of objects after having examined and tested a determined percentage of the total number.

Silo Granaries

The Equipment of Silo Granaries, R. A. Sidley. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 68-73, 13 figs. General operations carried out in a silo granary.

Tanks, Storage

Round Storage Tanks for Liquids, H. Eisert. Monthly Jl. Engrs. Club of Baltimore, vol. 7, no. 8, Feb. 1919, pp. 155-168, 6 figs. Design formulæ and calculations.

Electrical Engineering

ELECTROCHEMISTRY

Electrolytic Cell

Influence of a Magnetic Field and of a Mechanical Agitation of Electrolyte on the Potential Difference at the Terminals of an Electrolytic Cell (Influence d'un champ magnetique et d'une agitation mécanique du bain sur la difference de potential aux bornes d'une cuve électrolytique), Toshikozu Mashimo. Revue Générale de l'Electricité, vol. 5, no. 1, Jan. 4, 1919, pp. 17-18. Experiments with platinum electrodes in semi-normal solutions of iron chloride. From Memoirs of the College of Science, Kyoto Imperial Univ., vol. 2, no. 6, Oct. 1917, pp. 341-347.

Storage Batteries

Hypothesis Concerning the Action of the Negative Plate in a Lead Storage Battery (Hypothèse sur le fonctionnement de la plaque négative de l'accumulateur au plomb), Ch. Féry. Industrie Electrique, year 27, no. 636, Dec. 25, 1918, pp. 467-468. Experiments with litharge and platinum and electrodes lead author to believe that negative electrode passes to Pb_2SO_4 during discharge.

ELECTRODEPOSITION

Nickel Plating of Cast Iron

Depositing Nickel on Cast Iron from a Hot Electrolyte, Roay F. Clark. Metal Rec. & Electroplater, vol. 4, no. 11, Dec. 1918, pp. 401-402. Results achieved by plater on shears and scissors with data extending over long period; advantages of hot process.

Silver and Gold Refining

Electrolytic Silver and Gold Refining at Perth Amboy, N. J., Geo. G. Griswold, Gen. Meeting Am. Electrochem. Soc., Apr. 3-5, 1919, advance copy, paper 1, pp. 1-7, 8 figs. Refining silver bullion by Moebius process at works of Am. Smelting & Refining Co.; Wohlwill plant for electrolytically refining gold bullion and recovering from it platinum and palladium.

ELECTROPHYSICS

Alternating Currents

Mean Power and Power Factor in a Non-Sinusoidal Alternating-Current Circuit (De la puissance moyenne et du facteur de puissance dans un circuit à courants alternatifs non sinusoïdaux), H. Pécheux. Revue Générale de l'Electricité, vol. 4, no. 22, Nov. 30, 1918, pp. 813-816, 2 figs. Calculation of cos ϕ from oscillographic records. Method followed for determining non-sinusoidal electromotive force is the one published in R. G. E., Feb. 8, 1918.

Cable, Armored, Resistance of

Effective Resistance and Reactance of a Three-Phase Armored Cable to Current Harmonics (Sur la résistance et la réactance effectives d'un cable armé triphasé pour les harmoniques du courant), R. Swyngedauw. Revue Générale de l'Eléctricité, vol. 5, no. 1, Jan. 4, 1919, pp. 16-17. Deduces from results of experiments that for third harmonic of fundamental frequency 50 per sec. resistance is comprised between 0.67 and 0.78 ohm per km., and reactance between 0.45 and 0.56 ohm. per km.

Long Conductors

Some Experiments with Long Electrical Conductors, John H. Morecroft. Elecn., vol. 81, no. 2116, Dec. 6, 1918, pp. 658-660, 7 figs. From paper before Inst. of Radio Engrs.

Long-Line Phenomena

Long Line Phenomena and Vector Locus Diagrams, Edy Velander. Elec. World, vol. 73, no. 5, Feb. 1, 1919, pp. 212-216, 12 figs. Long-line transmission problems may be readily solved by the use of rigorous hyperbolic equations of very simple form; an anlysis of equations of this form with vector diagrams for graphical interpretation.

Parallel Conductors

Determination of the Resistance and Impedance of Any Number of Parallel Conductors (Détermination de la résistance et de l'impédance d'un nombre quelconque de conducteurs associés en parallèle), P. de Bancarel. Revue Générale de l'Electricité, vol. 4, no. 26, Dec. 28, 1918, pp. 989-990, 3 figs. Graphical process based on representation of resistances by trigonometric tangents. Simplification of method suggested by Haudié in Revue Générale de l'Electricité, vol. 3, Aug. 31, 1918, p. 297.

Paramagnetism

The Quantum Theory of Paramagnetism (Zum Quantentheorie des Paramagnetismus), Fritz Reiche. Annalen der Physik, Leipzig, vol. 54, no. 22, 1917, pp. 401-436, 7 figs. Discusses the kinetic theory of paramagnetism from the differential equations proposed by Jacobi, Hamilton, and Planck, and compares them with tests made by Kamerlingh Onnes and Oosterhuis.

Quenched Sparks

Processes Occurring in a Quenched Spark (Ueber die Vorgaenge in sogenannten Loeschfunken), V. Pieck. Annalen der Physik, vol. 54, no. 19, pp. 197-244, 14 figs., 3 plates. Relates to electrical vibrations leading to shock. Experiments with various gases at different pressures and with magnesium electrodes. Dynamic theory of quenched sparks. Ions and electrons. Tests at University of Goettingen.

Short-Circuits

Substation Short-Circuits R. F. Gooding. Elec. Jl., vol. 16, no. 2, Feb. 1919, pp. 61-65, 6 figs. Calculations to determine stresses to which oil circuit breakers, disconnecting switches, bus supports, etc., may be subjected in substations fed by parallel feeders at a time of short circuit. Several typical examples of special systems are selected.

Transverse Magnetization

The Influence of Transverse Magnetization on the Electrical Resistance of Tellurium (Ueber den Einfluss transversaler Magnetisierung auf den elektrischen Widerstand von Tellur), Bengt Beckman. Annalen der Physik, vol. 54, no. 19, 1917, pp. 182-196. Measurements given of the electrical resistance of rods of tellurium and other rare metals at various temperatures.

See also MECHANICAL ENGINEERING, Motor-Car Engineering (Spark Plugs)

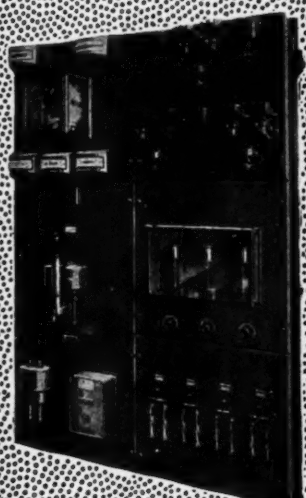
FURNACES

Electrically Heated Ovens

Electrically-Heated Ovens. Iron Age, vol. 1003, no. 3, Jan. 16, 1919, pp. 188-189, 2 figs. Construction and operation of enameling ovens; efficiency of different types compared.

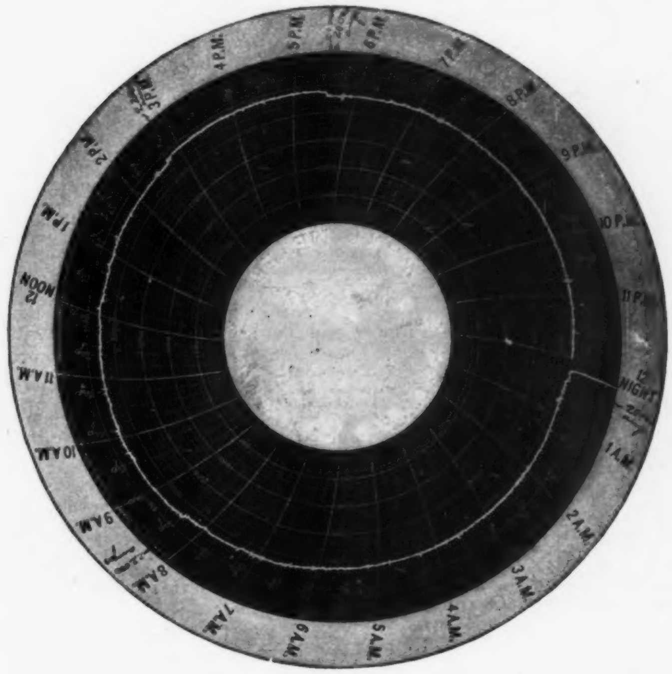
G-E Control Equipment for Electric Arc Furnaces

ELECTRIC FURNACE TRANSFORMER



PRIMARY AND SECONDARY CONTROL

Abrasives, carbides and ferro-alloys are most efficiently produced in electric arc furnaces having close power input regulation.



The above chart shows why G-E control equipment gives the greatest output of alloys per kilowatt hour input and how closely the power input to a large calcium carbide furnace was regulated by a G-E automatic control equipment. Twelve of these regulators are now being installed in the great Nitrate Plant now under erection by the Air Nitrates Corporation.

For further details consult the nearest local office of this company. District offices are listed below, local offices are in all large cities.

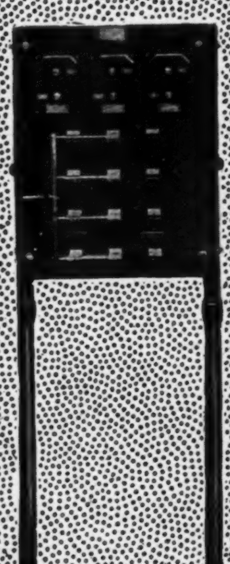
43-71

General Electric Company

General Office: Schenectady, N. Y. District Offices in:

Atlanta, Ga. Chicago, Ill. Boston, Mass. Cincinnati, Ohio San Francisco, Cal.
New York, N. Y. St. Louis, Mo. Denver, Colo. Philadelphia, Pa.

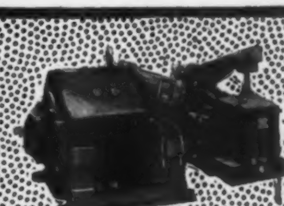
Sales Offices in all Large Cities



AUXILIARY ELECTRODE REGULATING PANEL

MOTOR-GENERATOR SET

ELECTRODE MOTOR



TILTING MOTOR

Electrically-Heated Ovens. Metal Rec. & Electroplater, vol. 4, no. 11, Dec. 1918, pp. 395-396, 3 figs. Material for walls, insulation, floors; disadvantages of through metal; four general types; efficiency of the various forms.

Metallurgical Furnaces

Electric Furnace Developments, J. Bibby. Iron & Coal Trades Rev., vol. 97, no. 2652, Dec. 27, 1918, pp. 719-722, 7 figs. Abstract of paper before Cleveland Inst. of Engrs.

Application of the Electric Furnace to the Metallurgy of Iron and Its Alloys, H. Etchells. Elecn., vol. 81, no. 2119, Dec. 27, 1918, pp. 734-735. Abstract of paper read before the National Association of Industrial Chemists, November, 1918.

Electric Furnaces for Steel Foundry Work, W. E. Moore. Blast Furnace, vol. 7, no. 1, Jan. 1919, pp. 76-77. Basic steel recommended on account of possibility of working to closer phosphorus and sulphur limits. Advocates furnace shell of large diameter with shallow bath.

Rennerfelt Furnace

Developments in the Rennerfelt Furnace, H. A. De Fries and Jonas Hertenius. Iron Age, vol. 103, no. 3, Jan. 16, 1919, pp. 190-191, 1 fig. Important changes from original design; side electrodes now tilt; shape of shell is round.

Small Furnaces

Performance of Small Electric Furnace. Am. Drop Forger, vol. 4, no. 12, Dec. 1918, pp. 477-479, 9 figs. Operation and equipment of two-ton electric furnace installed at nichrome plant.

GENERATING STATIONS

Canada

Statistical Analysis of the Central Electrical Station Situation of Canada. Contract Rec., vol. 33, no. 5, Jan. 29, 1919, pp. 88-92, 7 figs. From data compiled by Dominion Water Power Branch of Department of the Interior, in cooperation with Bureau of Statistics of Department of Trade and Commerce.

Floating Station

Floating Electric Power Station. Engineering, vol. 106, no. 2762, Dec. 6, 1918, pp. 644-645, 6 figs. Description of flatting power station built and operated during war for providing current for variable conditions overseas where mobility and convenience were of importance.

Legal Liability

Liability of Central Station Company for Failure of Electric Power, Chesla C. Sherlock. Elec. Rev., vol. 74, no. 6, Feb. 8, 1919, pp. 216-217. Several decisions covering the question of power failure, both through negligence of employees of utility company and breach of contract.

Three-Phase-Two-Phase Type

Features of Three-Phase-Two-Phase Generating Station. Elec. Rev., vol. 74, no. 3, Jan. 18, 1919, pp. 85-88, 9 figs. Installation and operation features of Eastern Wisconsin Electric Co.'s Sheboygan plant.

GENERATORS AND MOTORS

Asynchronous Motors

Asynchronous Motor Diagram (Le diagramme des moteurs asynchrones), L. Lagron. Revue Générale de l'Electricité, vol. 4, no. 23, Dec. 7, 1918, pp. 861-863, 1 fig. Indicates method of constructing diagram knowing only value of currents in short-circuit, their angular displacements and resistance of stator and rotor.

Carbon Brushes

Characteristics of Carbon Brushes for Electrical Machinery, Warren C. Kalb. Power, vol. 49, no. 6, Feb. 11, 1919, pp. 202-204, 2 figs. Carrying capacities, contact drop, coefficient of friction, abrasiveness and hardness of carbon brushes defined and methods for determining these characteristics explained.

Cooling

Cooling Electric Motors, D. A. Mossay. Colliery Guardian, vol. 116, no. 3024, Dec. 13, 1918, pp. 1239-1240, 6 figs. From paper before Min. Inst. of Scotland.

Air-Cooled Electrical Search Light (Di uno speciale dispositivo ad arco raffreddato per proiettori di luce), Virgilio Bellini. Elettrotecnica, vol. 5, no. 21, July 25, 1918, pp. 286-287, 1 fig. Rotary positive carbon is cooled by air jet.

Design

The Advantages of Uniform Motor Design, James Burke. Elec. Wld., vol. 73, no. 4, Jan. 25, 1919, pp. 172-175. From a paper the Electric Power Club, Cleveland, Ohio, January, 1919.

Dynamical Theory

The Dynamical Theory of Electric Engines, Llewelyn B. Atkinson. Jl. Instn. Elec. Engrs., vol. 57, no. 277, Dec. 1918, pp. 1-26, 26 figs. Kelvin's ideas concerning mechanical values of distributions of electricity, magnetism and galvanism; energy relations of electric and magnetic systems; constructive fundamental types of electric engines converting electric energy into mechanical work; possible primary types of electric engines; engines converting mechanical work into electrical energy; combined generator and motor cycles; similarity between expressions for efficiencies of ideal electric engines and general form of expression for efficiency of a perfect heat engine. Tenth Kelvin Lecture.

Induction Motors

The Interchangeability of Induction Motors, Gordon Fox. Ry. Elec. Engr., vol. 10, no. 1, Jan. 1919, pp. 5-8, 4 figs. Indicates necessary alterations in windings which will adapt motors for use on currents of different frequency and phase.

Polyphase Induction Motor

Diagram of Polyphase Induction Motors Taking into Account Magnetic Saturation (Diagramme des moteurs polyphasés asynchrones tenant compte de la saturation magnétique), J. Berthenod. Revue Générale de l'Electricité, vol. 4, no. 25, Dec. 21, 1918, pp. 941-946, 6 figs. The various fluxes are reduced to three, a common flux and two others having leakages proportional to primary and secondary currents, respectively; an approximate diagram is thus formed; another diagram is then developed which takes into account actual operating conditions.

Power and Torque

Power and Torque in Electric Motors, Justin Lebovici. Elec. Rev., vol. 74, nos. 4 and 6, Jan. 25 and Feb. 8, 1919, pp. 134-136 and 213-215, 18 figs. Articles discussing principles of different types of motors from a common standpoint; relations in single-phase induction and repulsion motors.

Rebuilding Generators

Rebuilding 25,000-kw. Generator, Thomas Wilson. Power, vol. 49, no. 3, Jan. 21, 1919, pp. 76-79, 11 figs. Account of rebuilding of generator of Commonwealth Edison Co., Chicago, which required upturning of 200-ton unit within space of its own foundation.

Winding

A New Graphic Method for Winding Schemes, L. Fleischmann. Elecn., vol. 81, no. 2117, Dec. 13, 1918, pp. 689-690, 3 figs. Abstract of article in Elektrotechnische Zeitschrift, No. 7, 1918.

LIGHTING AND LAMP MANUFACTURE

Colored Light

Linking Science and Art in Lighting, M. Luckiesh. Elec. Rev., vol. 74, no. 1, Jan. 4, 1919, pp. 14-15. Possibilities of colored light. (Fourth article.)

Home Lighting

Linking Science and Art in Lighting, M. Luckiesh. Elec. Rev., vol. 74, no. 5, Feb. 1, 1919, pp. 171-173, 2 figs. Fifth of a series of six articles. The lighting of a middle-class home.

Light, Measurement of

Photometric Apparatus for Measuring the Illuminating Value of Fluctuating Sources of High Candle Power. Gas Jl., vol. 144, no. 2902, Dec. 24, 1918, p. 658, 3 figs. Tube photometer and supplementary flare photometer which permit measurements of detail revealing power in its relation to rapidly-burning flares of great intensity. From presidential address to Illum. Eng. Soc.

MEASUREMENTS AND TESTS

Boucherot Wheatstone Bridge

On Boucherot's Constant-Current Distributions (Sur les distributions à intensité constante de M. Boucherot), Tr. Lalesco. Revue Générale de l'Electricité, vol. 4, no. 26, Dec. 28, 1918, pp. 987-988, 3 figs. Shows that in Wheatstone-bridge arrangement for transforming constant-potential alternating current into one of constant intensity, it is not necessary that the four resistances be equal and operation may be secured by having two of the branches of equal resistance and opposite sign.

Indicating Instruments, Hysteresis of

The Determinateness of the Hysteresis of Indicating Instruments, F. J. Schlink. Jl. Wash. Acad. Sci., vol. 9, no. 2, Jan. 19, 1919, pp. 38-45, 2 figs. Hysteresis determinations of non-integrating mechanical measuring instruments require no unusual care, and are fully reproducible.

Magnet Testing

Testing Permanent Magnets by Means of a Voltmeter. Elec. Wld., vol. 73, no. 6, Feb. 8, 1919, pp. 267-268, 1 fig. Magnetometer may be devised by modifying a d'Arsonval type voltmeter; descriptions of useful tests.

Porcelain Insulators

Photographic Study of Porcelain Insulators, Harold G. Tufty. Elec. Wld., vol. 73, no. 6, Feb. 8, 1919, pp. 268-271, 3 figs. Polarized light employed in examination of thin sections of insulators some of which have been properly fired while others were underfired and still others overfired; observations on used insulators.

Railway Motor Testing

Railway Motor Testing—II. Elec. Jl., vol. 16, no. 2, Feb. 1919, pp. 76-79, 3 figs. Survey of practical methods accepted by operating companies. Armature testing of standard four-pole lap or two-circuit wound 500-volt railway motors.

Resistance Measuring by Voltmeter

On the Voltmeter Method of Measuring Resistances (Note sur la mesure d'une résistance par la méthode du voltmètre), H. Panchon. Revue Générale de l'Electricité, vol. 4, no. 25, Dec. 25, 1918, p. 972, 1 fig. In formula $X = (E - U)\ R/U$, RE is called K and expression reduced to $(X + R)\ U = K$. The graph presented gives X in terms of U. Discussion of Puget's method in R. G. E. Aug. 31, 1918.

Thermocouples and Pyrometers

Checking Calibration of Thermocouples and Pyrometers. Elec. Rev., vol. 74, no. 2, Jan. 11, 1919, pp. 56-59, 6 figs. Sources of error in thermocouples, pyrometers and leads; methods of testing works units against secondary and works standards; maintenance of standards; apparatus recommended for carrying on work.

Voltage Measurement

The Measure of High Voltages by Means of Klingelfuss Sclerometer (La mesure des hautes voltages au moyen du scléromètre Klingelfuss), Paul Joye. Archives des Sciences Physiques et Naturelles, vol. 46, Nov. 1918, pp. 243-251. An independent third circuit is introduced in induction coil in space which separates right and left portions of secondary winding; this circuit connected to a voltmeter is the sclerometer.

Watt-Hour Meters

Testing Single-Phase Watt-Hour Meters Using a Rotating Standard, P. B. Findley. Power, vol. 49, nos. 4 and 5, Jan. 28 and Feb. 4, 1919, pp. 118-121 and 168-171, 18 figs. Jan. 28: Considers meter used on distributing circuits and method of testing it, using an indicating watt-meter; Feb. 4: Construction of rotating standard watt-meter is described and application to testing single-phase watt-hour meters discussed.

See also RAILROAD ENGINEERING, Street Railways (Tests); ELECTRICAL ENGINEERING, Transmission, Distribution, Control (Meters)

POWER APPLICATIONS

Agriculture, Italy

Application of Electricity to Agriculture in Italy (Applicazioni agricole dell' elettricita con riferimento speciale alle condizioni dell' Arzo Romano), D'Escani Alessandro. Annali d'Ingegneria e d'Architettura, year 33, no. 21, Nov. 1, 1918, pp. 330-332. Discusses necessity for wider application of electricity to agriculture, especially for ploughing, threshing, pressing hay and straw, and for pumping water for irrigation purposes.

Coal Mines

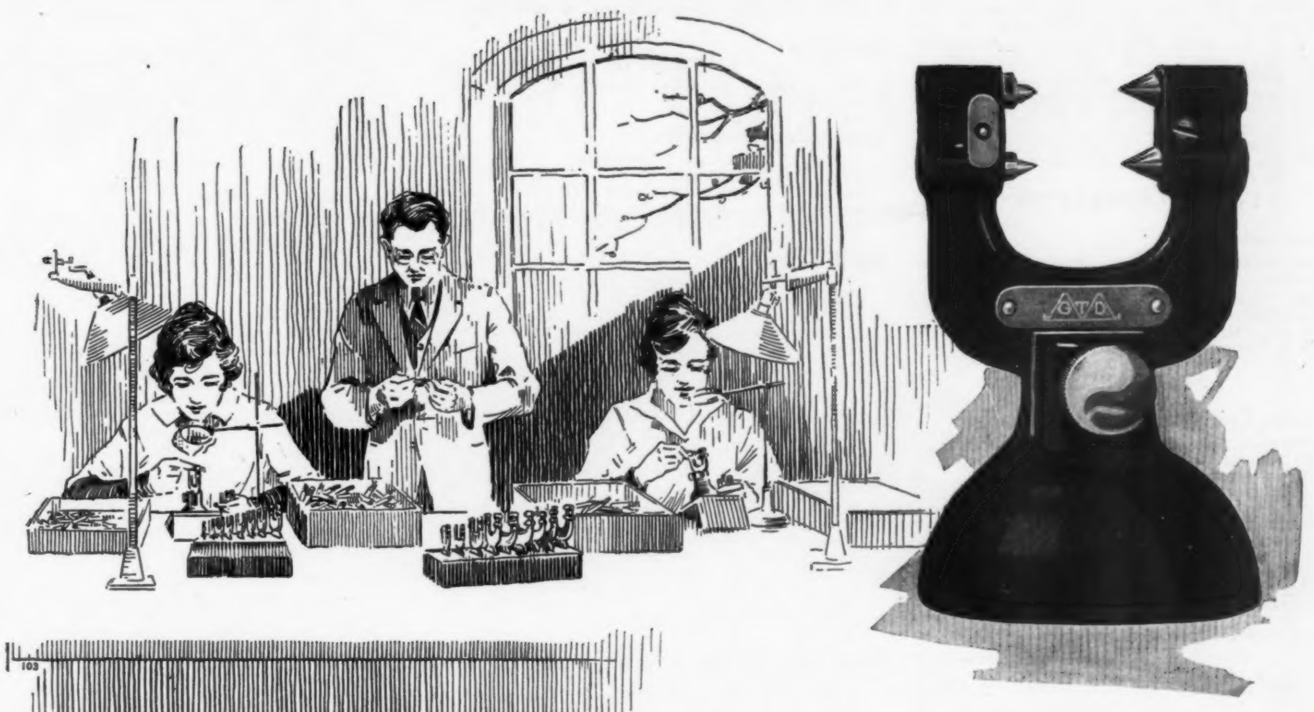
The Electric Installations of the Coal Mines in Blackhall, England (Les installations électriques des charbonnages de Blackhall, Angleterre). Génie Civil, vol. 74, no. 1, Jan. 4, 1919, pp. 1-4, 6 figs.

Shop Motors

Light, Electricity and the Shop, C. E. Clewell. Am. Mach., vol. 50, no. 4, Jan. 23, 1919, pp. 163-167, 11 figs. Motors for drilling and boring machines.

Steel-Mill Drives

Electric Steel Mill Drive Developments, Brent Wiley. Blast Furnace, vol. 7, no. 1, Jan. 1919, pp. 35-37, 5 figs. Consideration given to standardization; variation in mill schedule permitted by flexibility of electric drive; tendency toward central station and 60-cycle apparatus.



GTD
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Electrically-Driven Plate Mills, G. E. Stoltz. Elec. Jl., vol. 16, no. 2, Feb. 1919, pp. 68-73, 10 figs. Typical steel mill drives; torque curves of induction motor at various r.p.m. rolling plate from slab; graphic chart of load on a 90-in. plate mill; power consumption. Paper read before Phila. Section Assn. Iron & Steel Elec. Engrs.

Modern G. E. Electric Steel Mill Drives. Blast Furnace, vol. 7, no. 1, Jan. 1919, p. 37. Electric drive operating 1200-ton hydraulic bloom shear with rapid acceleration and retardation and distance control.

POWER GENERATION

Hydroelectric Plants

See Power Generation, Mechanical Engineering.

See also MARINE ENGINEERING, Ships (Electrical Installation Work; Electric Propulsion); ORGANIZATION AND MANAGEMENT, Transportation (Electric Trucks)

STANDARDS

Aluminum Conductors, Standards for

Proposed Specifications for Aluminum Electrical Conductors (Project de conditions de réception des conducteurs d'électricité en aluminum). Revue Générale de l'Electricité, vol. 4, no. 24, Dec. 24, 1918, pp. 931-933. Preliminary report submitted to l'Union des Syndicats by one of their sub-committees. Report comprises chemical definition, mechanical resistance, modulus of elasticity, flexibility, coefficient of expansion and electrical conductivity of aluminum.

Current and Potential Standards

A New Standard of Current and Potential, Chester T. Allcutt. Elecn., vol. 81, no. 2117, Dec. 13, 1918, pp. 684-685, 6 figs. Abstract of paper before the American Institute of Electrical Engineers.

Standardization Division in Plants

Standardization Division in a Plant Manufacturing Electrical Material (Organisation d'un service d'études des normalisations dans une usine de constructions électriques), J. Fièvez. Revue Générale de l'Electricité, vol. 4, no. 25, Dec. 21, 1918, pp. 975-978, 1 fig. Suggests division, under direction of technical department, to study selection of standards that will meet all conditions which may be required by public. Functions of proposed division and its relation to various other departments are outlined.

Wave-Shape Standards

Review of Work of Sub-Committee on Wave Shape Standard of the Standards Committee, Harold S. Osborne. Proc. Am. Inst. Elec. Engrs., vol. 38, no. 1, Jan. 1919, pp. 1-28, 12 figs. Recommends that for the present the 10 per cent deviation rule should be retained and that trial use should be made of a supplementary wave-shape factor, based on the relation between voltage wave shape and interfering effect in telephone circuits when power and telephone lines parallel each other.

TELEGRAPHY AND TELEPHONY

Cables, Fault Location in

A Useful Arrangement of the Murray Loop Test, L. J. Sell. Post Office Elec. Engrs. Jl., vol. 2, pt. 4, Jan. 1919, pp. 225-228, 3 figs. Applicable in case of cable fault when some wires only are seriously affected and a good wire of same gage and length as faulty wires is available.

Fault Location Tests, J. B. Salmon. Post Office Elec. Engrs. Jl., vol. 2, pt. 4, Jan. 1919, pp. 215-224, 5 figs. Examination of difficulties incidental with location of cable faults by Varley and Murray loop tests, Anderson and Kennelly overlap test and Blavier test. Conditions under which each of these tests is most suitable.

Central Battery System Telephones

Note on the C. B. S. Telephone System. Post Office Elec. Engrs. Jl., vol. 2, pt. 4, Jan. 1919, pp. 197-203, 6 figs. Essential features of central battery system and comparison with present signaling system; study of main characteristics desirable in an exchange designed for local battery talking and automatic calling and clearing.

Multiplex Telegraphy

Modus Operandi of Multiplex Telegraphy. Elec. Rev., vol. 74, no. 2, Jan. 11, 1919, pp. 49-51, 6 figs. Further details concerning principles and application of recently developed system of multiplex telephony and telegraphy; equipment and operation of Washington-Pittsburgh circuit.

Multiplex Telephony

New Multiplex System of Telephony. Elec. World, vol. 73, no. 1, Jan. 4, 1919, pp. 11-13, 5 figs. System developed to increase manifold the message-carrying capacity of long-distance telephone and telegraph wires; suggestive value of earlier undertakings in this field.

Phanoplex

Phanoplex Telegraphy (in Japanese), Y. Fuseno. Denki Gakkwai Zasshi, no. 364, Nov. 18, 1918.

Quadruplex Telegraphy

Morse Quadruplex Working. Post Office Elec. Engrs. Jl., vol. 2, pt. 4, Jan. 1919, pp. 209-214, 2 figs. Discusses conditions under which stable quadruplex working on aerial wires may be contained at all times.

Radio Telephony

Some Aspects of Radio Telephony in Japan, Eitaro Yokoyama. Wireless World, vol. 6, no. 70, Jan. 1919, pp. 569-574, 8 figs. Experiments on influence of electrode materials on discharge and of supply voltage on operation of discharger; static frequency transformer of T. Kujirai (Concluded). From Proc. Inst. Radio Engrs.

The Vision of a Scientist. Wireless World, vol. 6, no. 70, Jan. 1919, pp. 554-57. Remarkable forecasts of Sir William Crooks on wireless telegraphy. From Fortnightly Rev., Feb. 1892.

Sounder Silencers

Sounder Silences, R. T. King. Post Office Elec. Engrs. Jl., vol. 2, pt. 4, Jan. 1919, pp. 206-208, 2 figs. Modification of departmental relay no. 1000A so as to cause bell to ring when distant station holds down key for period of about ten seconds.

Telephone Circuits, Loaded

A Graphical Method of Calculating the Attenuation Constant of Loaded Telephone Circuits, E. S. Ritter. Post Office Elec. Engrs. Jl., vol. 2, pt. 4, Jan. 1919, pp. 187-196, 3 figs. Applicable only to loaded lines, including open wire aerial lines, underground and submarine cable.

Vacuum Tubes

The Development of the Vacuum Valve. Jl. Elec., vol. 42, no. 1, Jan. 1, 1919, pp. 20-22, 8 figs. Manufacturing details; uses in the war; importance in wireless telephony.

Developments in Radio Apparatus, George O. Squier. Elec. World., vol. 73, no. 3, Jan. 18, 1919, pp. 129-130. Application to radio communication of vacuum tube; improvements during war; airplane radio-telephone and radio-telegraph sets. From lecture before A. I. E. E. on Aeronautics in the United States from the Beginning of the War to the Present Time.

Theory of the Electric Oscillations in Vacuum Tubes (in Japanese), Y. Nozuki. Denki Gakkwai Zasshi, no. 365, Dec. 10, 1918.

See also ELECTRICAL ENGINEERING, Electrophysics (Quenched Sparks)

TRANSFORMERS, CONVERTERS, FREQUENCY CHANGERS

Charts

Formulæ and Charts Relative to the Working under Load of Industrial Transformers (Formules et abaques relatifs au fonctionnement en charge des transformateurs industriels), L. Dubar. Revue Générale de l'Electricité, vol. 4, no. 22, Nov. 30, 1918, pp. 817-821, 7 figs. Output and voltage drop at various loads and with different angular displacements, obtained from construction data and test results.

Electric-Furnace Transformers

High Intensity Transformers for Electric Furnaces (Etude sur le calcul de transformateurs à forte intensité pour fours electriques), R. Jacquot. Revue Générale de l'Electricité, vol. 4, no. 17, Oct. 26, 1918, pp. 602-617, 2 figs. Classification of transformers used in electrometallurgy; their respective losses and cost.

Oils

Some Characteristics of Transformer Oils, O. H. Eschholz. Elec. Jl., vol. 16, no. 2, Feb. 1919, pp. 74-76, 2 figs. Test figures comparing vapor pressures of transformer oil with those of liquids of well-known characteristics.

Starting Current

Calculation of Starting Current in A. C. Transformers for Electric Traction (Der Einschaltstrom von Wechselstrom-Transformatoren fuer die elektrische Traktion), W. Kummer. Schweiz. Bauzeitung, vol. 72, no. 24, Dec. 14, 1918, p. 233, abstracted from M. Vidmar's article in Elektrotechnik & Maschinenbau, 1918, p. 273. Gives formulæ for calculating the resistance capacity of idle transformers.

TRANSMISSION, DISTRIBUTION, CONTROL

Cables, High Tension

Experimental Investigation of High-Tension Cables, Tsunezo Hada. Denki Gakkwai Zasshi, no. 364, Nov. 10, 1918, 27 pp. 15 figs. Establishes as result of experiments that in a strand cable the minimum potential gradient or the maximum breakdown voltage is practically at position where $D/2h = e$, as in case of a single-core concentric cable.

Distribution Problems

North-Eastern Centre: Chairman's Address, A. P. Pyne. Jl. Instn. Elec. Engrs., vol. 57, no. 277, Dec. 1918, pp. 35-40. Question of generating electricity in bulk and its distribution over wide areas.

Insulators, Line

An Operating View of High-Tension Insulators, P. Ackerman. Elec. World, vol. 73, no. 3, Jan. 18, 1919, pp. 116-119, 4 figs. Severe operating conditions that have caused failure of line insulators; later designs of pin and suspension types promise to solve insulator problem for some years to come.

Application of Theory and Practice to the Design of Transmission Line Insulators, G. I. Gilchrest and T. A. Klinefelter. Elec. Jl., vol. 16, no. 1, Jan. 1919, pp. 8-16, 28 figs. Laboratory tests of various new designs and comparison of these designs with those now in commercial use.

Line Poles

When a Line Pole Needs a Guy, Charles R. Harte. Elec. Ry. Jl., vol. 53, no. 3, Jan. 18, 1919, pp. 139-142, 7 figs. Summary of experience of telephone and power companies as guide to electric-railway transmission-line construction.

Meters

Notes on Demand Meters, H. W. Richardson. Elec. World, vol. 73, no. 5, Feb. 1, 1919, pp. 219-222, 2 figs. Indicating demand meters for small and recording or curve-drawing meters for larger installations; principles upon which modern demand meters operate.

Phase Conversion

The Supply of Single-Phase Power from Three-Phase Systems, Miles Walker. Elecn., vol. 81, no. 2117, Dec. 13, 1918, pp. 682-684, 5 figs. Abstract of paper before the Institution of Electrical Engineers.

Power Conductors

Arrangement of Power Conductors. Jl. Elec., vol. 42, no. 2, Jan. 15, 1919, pp. 72-74, 9 figs. Recommendations for spacing of power lines as made by Cal. Committee on Inductive Interference. Figures and comparisons given apply to non-transposed circuits; comparisons of different configurations hold also for transposed circuits, provided circuits are transposed identically.

Power Control

The Control of Large Amounts of Power, E. B. Wedmore. Power House, vol. 11, no. 12, Dec. 1918, pp. 363-367, 5 figs. Limitation by sectionalizing and employment of feeder or busbar reactances. Paper before Instn. Elec. Engrs. (To be continued.)

Power Factor

Improving Power Factor by Use of Synchronous Motors (Emploi des moteurs synchrones pour ameliorer le facteur de puissance), Paul Rieunier. Revue Générale de l'Eléctricité, vol. 5, no. 1, Jan. 4, 1919, pp. 3-16, 5 figs. Investigation of the nature and the properties of surface represented by general equation $y = \pm\sqrt{1 - z^2} - xz$, which is a modification of expression $S/R = \sin\phi_1 - \cos\phi_1 \tan\phi_2$ (R. G. E., vol. 4, Nov. 23, 1918, pp. 771-788), where S is current in quadrature supplied by synchronous motor, R current without synchronous motor, and ϕ_1 and ϕ_2 phase angles before and after introduction of synchronous motor respectively; former equation is obtained by making $S/R = y$, $z = \cos\phi_1$, and $x = \tan\phi_2$.

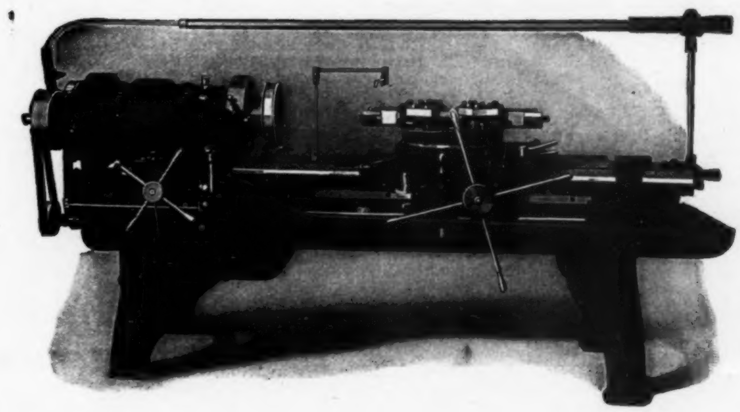
Power Transmission

Latest Developments in the Electric Transmission of Power, P. M. Lincoln. Jl. Cleveland Eng. Soc., vol. 11, no. 3, Nov. 1918, pp. 153-159 and (discussion) pp. 159-161. Limitation of direct-current transmission; early experiments in transmission by alternating current; Tesla's patents in 1889; Mershon's first observations of corona phenomena; the 40,000-volt installation at Telluride Power Co.; recent discoveries concerning nature of coronas.

Relays

The Orling Jet Relay (Le relais Orling à jet), J. Pomey. Revue Générale de l'Electricité, vol. 4, no. 24, Dec. 14, 1918, pp. 899-900, 2 figs. Usage in extensive cable lines of relays constructed on electrocapillary principles.

Hartness Flat Turret Lathes



The Hartness Flat Turret Lathe with cross-sliding head is made in two sizes, and may be furnished with an equipment of tools for either bar work or chuck work, or a double equipment for both bar and chuck work.

The smaller machine is called the 2¼ x 24-inch, and when equipped with the automatic die outfit of tools it turns nearly every conceivable shape from the bar, up to 2¼ inches diameter and 24 inches of length. On chuck work its capacity is 12½ inches diameter or less.

The 3 x 36-inch size handles bars of stock up to 3 inches in diameter, turning pieces up to 36 inches in length. It may also be equipped for chuck work up to 14½ inches in diameter.

SPECIAL FEATURES

The Original Flat Turret

The Flat Turret was put on the market in 1891. Over twelve thousand (12,000) machines equipped with them have been built and sold since, to the great satisfaction of the users. A large, steady tool clamping surface, a circular gib holding the turret down clear around its periphery, a locking pin directly under the cutting point of the tool—all these features combined to set a new standard of output, accuracy and range of work in turret lathe practice.

The unique set of tools employed covered at one leap the evolution from the old-fashioned "screw machine" to the modern turret lathe. It enabled the turret lathe to practically displace the engine lathe on bar, shaft and stud work.

The Cross-Sliding Head

This feature, introduced in 1903, still further extended the field of the turret lathe, making it the standard machine for most chuck work of moderate size. The Cross-Sliding Head has three advantages: (1) It offers a cross-sliding motion, gibbed directly and securely to the bed. There is no piling of slide on slide, no narrow bearing foundation for a lofty superstructure of slide, tool holder and tool. (2) It permits the cross feed to be applied to every tool on the turret if necessary. (3) By allowing a cross adjustment to every tool, complicated and costly special tools are minimized. The regular outfit covers all regular work. The design is so stable that the piloted type of holder is seldom needed.

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Holland: Spliethoff, Beeuwkes & Co., Rotterdam

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Substations

Automatic Substations on the North Shore Line, Charles H. Jones. Elec. Ry. Jl., vol. 53, no. 2, Jan. 11, 1919, pp. 84-90, 8 figs. Three new substations in operation and another under construction save 177 miles of 500,000-cir. mils cable worth $650,000.

Switches, Oil

Oil Switches (Considérations sur les disjoncteurs à l'huile), W-A. Coales and W-H. Wadmore. Revue Générale de l'Electricité, vol. 4, no. 23, Dec. 7, 1918, pp. 882-887, 7 figs. Provisions which must be made in designing them; their use in connection with time lag relays; characteristic factors; installation.

Wiring, Transmission

Ornamental Electric Transmission Wiring (Zur Aesthetik des Linienbaues bei elektrischen Freileitungen). Dr. P. Neusch-Sigrist. Bern. Schweiz. Elektrotech. Verein Bulletin, vol. 9, no. 12, December 1918, pp. 277-289, 13 figs. Calls attention to the desirability of underground wiring, where feasible, and to the need of using judgment and good taste in the design and location of exposed wire supports.

Civil Engineering

BRIDGES

Aqueduct

Aqueduct Crossing Under the Red River, for Winnipeg Water Supply, J. Armstrong. Contract Rec., vol. 33, no. 4, Jan. 22, 1919, pp. 63-67, 13 figs. Plans, cross section and details. Vertical shafts are 60 ft. deep, horizontal tunnel 1030 ft. long.

Bascule Bridge

138-Ft. Bascule Bridge at the Entrance of La Seyne Port, Toulon Roadstead (Pont basculant de 42 mètres de portée à l'entrée du port de la Seyne, rade de Toulon). Génie Civil, vol. 73, no. 23, Dec. 7, 1918, pp. 441-444, 25 figs. Detailed description of new French design in which span is raised to perfectly vertical position by articulated system of levers.

Combination Girder and Arch

An Unusual Bridge Design, Contract Rec., vol. 33, no. 4, Jan. 22, 1919, p. 74, 1 fig. Reinforced concrete structure which is combination of girder and arch design.

Design

Finding the Most Advantageous Construction of a Bridge by Graphical Methods (Die wirtschaftlich guenstigste. Anordnung einer Brueckenanlage auf zeichnerzischem Wege), Prof. Robert Schoenhoefer, Braunschweig. Zeitschrift fuer Bauwesen, vol. 68, no. 10 to 12, 1918, pp. 502-515, 4 figs. Author refers to his book of same title, (1916, Berlin), as well as to 1916 volume of the Zeitschrift, in which he showed the layout for any bridge up to 10 arches. The present work extends this to bridges with any number of arches. The aim is to find the design involving the least cost of construction. The method succeeds where calculations alone would fail.

Long Span

The Reconstruction of a Notable Railroad Bridge. Ry. Age, vol. 66, no. 4, Jan. 24, 1919, pp. 238-243, 9 figs. Reconstruction of the Ohio River Crossing at Louisville, containing the longest simple riveted span in the world.

Materials

Data on Concrete and Steel Bridges, John W. Towle. Concrete Age, vol. 29, no. 3, Dec. 1918, pp. 16-18. Points out it is best to have shorter spans of concrete, longer ones of steel. Address delivered before North Carolina Good Roads Assn.

Steel

Steel Bridge Replacements on the Sydney subdivision of Canadian Government Railways. A. H. Jones. Contract Rec., vol. 33, no. 2, Jan. 8, 1919, pp. 28-30, 6 figs. Account of alterations in masonry piers and replacements of light spans in 16 steel bridges and viaducts.

Strengthening

Stokesay Bridge, Shropshire, W. Noble Twelvetrees. Engineering, vol. 107, no. 2766, Jan 3, 1919, pp. 3-6, 17 figs. Strengthening a Telford cast-iron bridge by ferro-concrete arch ribs.

Strengthening a Long Steel Viaduct. Ry. Maintenance Engr., vol. 15, no. 1, Jan. 1919, pp. 9-10, 3 figs. Measures taken by Chicago & Eastern Illinois Ry. to reinforce long steel viaduct so as to permit of its use by heavy locomotives.

Stresses

Contraction Stresses in Bridge and Roof Trusses (Von der Schrumpfarbeit am Fachwerk), Leopold Ellerbeck, Berlin. Zeitschrift fuer Bauwesen, vol. 68, no. 10 to 12, 1918, pp. 474-502, 27 figs. Scientific analysis of the distortions found in all kinds of trusses. Considers the forces exerted upon a group of members.

Wilson Bridge, Lyons

The Sejourne System Wilson Bridge at Lyons, France. Eng. & Contracting, vol. 51, no. 4, Jan. 22, 1919, pp. 74-76, 1 fig. Description of certain features of design and construction.

BUILDING AND CONSTRUCTION

Caisson Method

The Caisson Method for Foundations and Mine Shafts. George R. Johnson. Proc. Engrs.' Soc. Western Pa., vol. 34, no. 7, Oct. 1918, pp. 489-514 and (discussion) pp. 514-518, 20 figs. General survey of applications of caisson method in building foundations, bridge piers, and mine shafts, with numerous illustrative examples.

Dams

See Earthwork, Rock Excavation, etc., on page 330.

Floors

Test of a Flat Slab Floor of the Western Newspaper Union Building, Arthur N. Talbot and Harrison F. Gonnerman. Univ. Ill. Bul., vol. 15, no. 39, bul. 106, May 27, 1918, 52 pp., 22 figs. Building was nine years old at time of test. Stresses up to 30,000 lb. sq. in. were developed in reinforcing bars. Information is given extensively on action of slab in its various parts.

Test of a Mixedstone Floor (Essai d'un plancher Mixedstone). Bulletin Technique de la Suisse Romande, year 44, no. 26, Dec. 28, 1918, pp. 233-235, 12 figs. Mixedstone floors are made of separate reinforced concrete standard parts which are placed and cemented together to form a continuous structure. Tests were conducted at University of Paris to ascertain modulus of elasticity, relative flexibility and ultimate strength of this construction.

Heathcote Precast Construction

A New System of Reinforced Concrete Construction. Engineer, vol. 126, no. 3287, Dec. 27, 1918, pp. 551-552, 4 figs. Description of the Heathcote system of precast concrete construction.

Houses

Fifty Double Wall Houses for Carnegie Employees. Concrete, vol. 14, no. 1, Jan. 1919, pp. 24-27, 8 figs. Five-and six-room houses with double 4-in. concrete walls.

281 Fireproof Dwellings Built of Large Precast Concrete Units, Harvey Whipple. Concrete, vol. 14, no. 1, Jan. 1919, pp. 3-8, 26 figc. Layout of housing development and details of houses built at St. Louis for Youngstown Sheet & Tube Co.

Pouring 75 All-Concrete Houses at Phillipsburg, N. J. Concrete, vol. 14, no. 1, Jan. 1919, pp. 9-14, 15 figs. Twenty-five houses are of four-room, bath and basement Ingersoll mold and 50 are from new mold producing six-room and bath house. Plans of houses and construction are shown.

Seventy-five Dwellings of Monolithic Concrete at Claymont, Del. Concrete, vol. 14, no. 1, Jan. 1919, pp. 15-19, 19 figs. Plans of four-, five- and six-room houses.

Build 20 All-Concrete Houses; Plan 20 Bungalows. Concrete, vol. 14, no. 1, Jan. 1919, pp. 20-23, 13 figs. Six-room and bath models but with exterior variation in roof and porch treatment to make attractive row.

Joints, Riveted

Rigidity of Riveted Joints of Steel Structures. Engineering, vol. 106, no. 2762, Dec. 6, 1918, pp. 638-640, 9 figs. From Bulletin No. 104, Engineering Experiment Station, Univ. of Ill.

Mill Building

Erecting a Building of Pre-Cast Concrete Units. Contract Rec., vol. 33, no. 3, Jan. 15, 1919, pp. 46-47, 9 figs. Columns, beams and trusses first cast as separate units on the ground and then erected after manner of steel building. Building in question is 160 ft. long, 200 ft. wide and 14 ft. high.

Oil House

Modern Steel Mill Oil House Installation. Blast Furnace, vol. 7, no. 1, Jan. 1919, pp. 49 and 59, 1 fig. Central distribution point for oil building is of concrete monolithic construction with brick curtain walls and steel sash 62 by 133 ft.

Reservoirs

18,000,000 Gallon Reservoir at Winnipeg. Engineer, vol. 126, no. 3287, Dec. 27, 1918, pp. 545-548, 11 figs. Features of design and construction.

Schools

High School at Ville St. Pierre, P. Q. Contract Rec., vol. 33, no. 1, Jan. 1, 1919, pp. 4-5, 2 figs. Elevation and plan of modern fireproof educational building.

Academy St. Bernard, Shawinigan Falls, Que. Contract Rec., vol. 33, no. 2, Jan. 1, 1919, pp. 8-9, 4 figs. Three-story brick building 140 × 58 ft.

Sewer

Rosedale Creek Sewer Extension, Toronto. Can. Engr., vol. 36, no. 3, Jan. 23, 1919, pp. 163-164, 4 figs. Circular brick sewer 2598 ft. long, 6 ft. 6 in. diameter, one per cent grade. Constructed partly in tunnel using compressed air.

Wing-Wall Abutments

Method and Formulas for Dimensioning Wing Wall Abutments, Benj. L. Parker. Eng. & Contracting, vol. 51, no. 4, Jan. 23, 1919, pp. 80-82, 5 figs.

CEMENT AND CONCRETE

Cement Manufacture, Economies in

Make Cement Cheaper; Save Two Million Tons Coal, F. G. McKelvy. Concrete, Cement Mill Section, vol. 14, no. 1, Jan. 1919, pp. 1-4, 7 figs. Theory and practice of power production by use of exhaust gases from cement kilns. Paper presented before Portland Cement Assn.

Cement, Properties of

Formation and Properties of Blast-Furnace Slag and Portland Cement (La formation et les propriétes des laitiers de haut fourneau et du ciment Portland), B. Neumann. Génie Civil, vol. 73, no. 26, Dec. 28, 1918, pp. 512-513. Chemical constitution and data of industrial value. From Stahl und Eisen, Oct. 17, 1918.

Concrete Strength and Mixing Lime

Effect of Time of Mixing on the Strength of Concrete, Duff A. Abrams. Am. Architect, vols. 114 and 115, nos. 2242, 2243, 2244 and 2246, Dec. 11, 18, 25, 1918 and Jan. 8, 1919, pp. 711-717, 745-750, 775-781 and 85-87, 30 figs. Report of tests conducted at Structural Materials Research Laboratory, Lewis Inst. Tests covered uniformity of machine-mixed concrete; study of time of mixing concrete on its consistency; effect of mix and size of aggregate on mixing time; study of rate of rotation of mixer drum; and effect of temperature of mixing water on strength of concrete. Paper for presentation to Am. Concrete Inst.

Concrete Tile

Making Concrete Tile for Government Housing. Concrete, vol. 14, no. 1, Jan. 1919, pp. 32-34, 4 figs. Concrete wall tile equivalent in volume to 10,000,000 common brick being manufactured for United States Housing Corporation of Department of Labor. Erection, equipment and operation of temporary factory on housing site.

Girder Poles

New Process for the Construction of Reinforced-Concrete Girder Poles (Nouveaux procédés pour la construction de pylones en béton armé), L. Perrin. Génie Civil, vol. 73, no. 23, Dec. 7, 1918, pp. 452-453, 6 figs. Manufactured in pieces of about 10 in. in height and provided with suitable grooves for steel members; when assembled grooves are covered with layer of cement mortar.

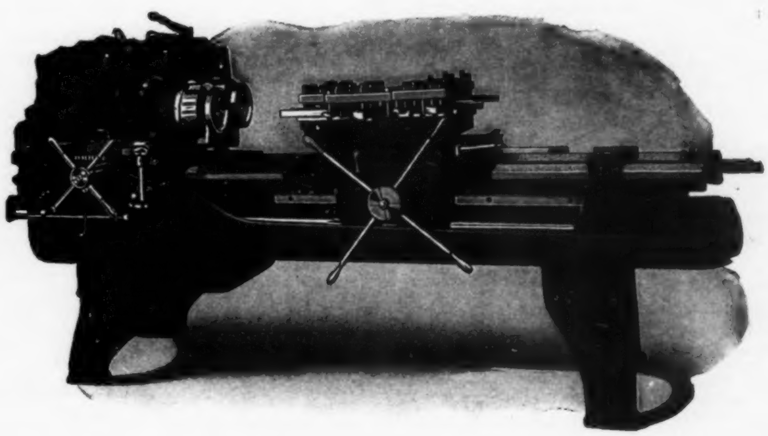
Iron Portland Cement

The Use of Iron Portland Cement in Reinforced Concrete, Edwin H. Lewis. Jl. West of Scotland Iron & Steel Inst., vol. 26, part 2, session 1918-1919, pp. 8-11 and (discussion) pp. 11-16, 5 figs. Records of furnace workings which show that in properly made iron portland cement (70 per cent clinker and 30 per cent water-granulated slag) there is no difficulty in keeping sulphur content below requirements of British standard specification.

Pneumatic Method of Concreting

The Pneumatic Method of Concreting, H. B. Kirkland. Contract Rec., vol. 33, no. 2, Jan. 8, 1919, pp. 25-27, 2 figs. Arrangement of plant. Pneumatic method consists in blowing batches of concrete through a pipe from a central point of supplies to their place in the concrete forms. Curve given shows amount of air required to convey concrete various distances.

The Double Spindle Hartness Flat Turret Lathe



The special field of usefulness for the "Double-Spindle" Hartness Flat Turret Lathe is in machining moderate sized castings, forgings, and certain limited classes of bar work in large lots for quantity of production. In addition it may be used as a single-spindle machine of larger capacity, in which case it is adapted to small lot manufacture.

The machine has all the good qualities of the Single-Spindle Flat Turret Lathe which we introduced nearly a quarter century ago. With the expiration of the original patents, the flat turret has been adopted by other makers as the standard design for manufacturing work. But our later developments, like the cross-sliding head and the essential features of the double spindle, are of great mechanical and economic value to the manufacturer and are found exclusively in these machines.

The double-spindle feature nearly doubles the output per operator and per machine.

Two spindles, two sets of tools, two pieces of work.

One turret, one machine, one operator, one set of motions.

SPECIFICATIONS

Working Range. Swing over ways is 17 inches when used as a single-spindle machine, 10½ inches when both spindles are used. Cross travel of head is 10½ inches. Hole through spindle is 3⅛ inches.

The Cross-Sliding Head. This is the only turret lathe in which the work-carrying headstock has a cross travel. This is indispensable on chuck work and is frequently convenient on bar work. It gives a cross feed for every tool without resorting to the frail double slide under the turret. Nine speeds in both directions from 20 to 298 revolutions per minute instantly obtainable. All gears run in oil bath.

The Turret. This is the original flat turret, 22 inches square, and is gibbed near outer edge. Index pin is located directly under working tool. On single-spindle work the corners of the turret can be used, giving eight positions in all.

The Power Feed. Both the carriage and the cross-sliding headstock are provided with power feed. It operates in both directions; has nine changes from 20 to 113 revolutions per inch of travel. These changes are instantly obtainable by sliding gears.

Stops. Each of the eight positions of turret is equipped with a separate stop, and there are four extra stops, making twelve in all. If desired, six stops can be used for one tool. The cross travel of the head is controlled by nine stops. Both sets of stops act in both directions and are placed as near as possible to the direct line of stress.

Floor Space for Machine is 5 x 10 feet. Approximate weight: net, 6600 pounds; crated, 6700 pounds; boxed for export, 7200 pounds. Cubic measurement, 240 cubic feet.

JONES & LAMSON MACHINE COMPANY

SPRINGFIELD, VERMONT, U. S. A.

109 Queen Victoria Street, London, E. C.

France, Spain and Belgium: F. Auberty & Co., 91 Rue de Maubeuge, Paris
Holland: Spliethoff, Beeuwkes & Co., Rotterdam

1 B

Reinforced Concrete

The Factor of Safety in Plain and Reinforced-Concrete Bodies Subjected to Uniform and Eccentric Pressures. Based on the Experiments of C. Bach and O. Graf. (Ueber den Sicherheitsgrad von bewehrten und unbewehrten Betonkoerpern, die auf zentrischen und exzentrischen Druck beansprucht werden. Unter Zugrundelegung der Forschungsarbeiten Heft 166-169). Armierten Beton, vol. 11, no. 9, Sept 1918, pp. 174-179, figs. 19 to 24. Mathematical discussion of stresses resulting from eccentric loads. Graphical solution of examples of loading causing deformations. Concluded in vol. 11, no. 10, Oct. 1918, pp. 190-195, figs. 25-27. Maximum compression strength found was 172.6 kg. per cm², maximum tensile strength, 24.9 kg. per cm².

Reinforced Concrete Under Simple Bending Stress (Der auf einfache Eigung beanspruchte Eisenbeton Querschnitt), Max Schendera. Armierter Beton, vol. 11, no. 10, Oct. 1918, pp. 195-199. Calculations, formula and tables pertaining to deflections in slabs. (To be continued.)

Setting Action

Present Knowledge of the Setting Action of Cement and Plasters. Cement & Eng. News, vol. 31, no. 1, Jan. 1919, pp. 22-25. Brief summaries of addresses presented at international discussion of subject held by Faraday Soc. of Lond. From Concrete.

Wasteful Construction

Useless Waste in Concrete Construction Due to Legal Requirements, W. Stuart Tait. Am. Architect, vols. 114 and 115, nos. 2242, 2243, and 2246, Dec. 11, 18, 1918, and Jan. 2, 1919, pp. 717-718, 750-752 and 79-84, 6 figs. Draws attention to developments which have taken place in analytical side of reinforced concrete design and to improvements in materials used; shows that there is now in existence a large force of skilled mechanics and general contractors fitted to construct reinforced concrete, as compared with time when present methods of design and stresses were established. (To be continued.)

Wear of Concrete

The Wearing Resistance of Concrete, Duff A. Abrams. Contract Rec., vol. 33, no. 4, Jan. 22, 1919, p. 77. Methods for determining maximum resistance to wear.

Winter Concreting

Concreting in Cold Weather. Mun. Jl., vol. 46, no. 1, Jan. 4, 1919, pp. 7-8. Suggestions offered by Portland Cement Assn.

See also MECHANICAL ENGINEERING, Pipe (Reinforced-Concrete Pipe)

EARTHWORK, ROCK EXCAVATION, ETC.

Blasting Pole Holes

Digging Pole Holes with Dynamite, C. R. Van Druff. Telephone Engr., vol. 21, no. 1, Jan. 1919, pp. 11-12, 4 figs. Hole is bored with 1.5-in. auger to within 1 ft. of desired depth; then charge is inserted and tamped down with earth and fired by blasting cap and fuse.

Crushed Stone

Standard Sizes of Crushed Stone from the Standpoint of the Producer, R. W. Scherer. Contract Rec., vol. 33, no. 1, Jan. 1, 1919, pp. 11-13. Affirms that standard sizes of crushed stone throughout the states are possible and highly desirable and proposes that nomenclature be confined to stating maximum and minimum sizes. Suggests 3, 2, 1½, 1, ½, ¼ in. as screen sections.

Dams

Hollow Concrete Dam at the Outlet of Lake St. Francois, O. Lefebvre. Contract Rec., vol. 33, no. 3, Jan. 15, 1919, pp. 42-45, 6 figs. Plan, elevation, typical section and details of construction. Project calls for expenditure of $101,000.

Big Eddy Conservation Dam. Can. Engr., vol. 36, no. 2, Jan 9, 1919, pp. 136 and 138. General dimensions of dam under erection at estimated cost of $1,750,000.

The Engineering and Construction of a Concrete Diverting Dam, George M. Bacon. Monthly Jl. Utah Soc. Engrs., vol. 4, no. 11, Nov. 1918, pp. 181-190, 8 figs. Sketch of dam on Boise River, which forms part of Payette-Boise project of U. S. Reclamation Service. River at point of dam has extreme minimum flow of 650 and a maximum of 40,000 cu. ft. per sec.

Reservoir

Building a Reservoir in a Cavernous Country. Ry. Maintenance Engr., vol. 15, no. 1, Jan. 1919, pp. 15-17, 2 figs. How danger of leakage through subterranean channels was avoided.

Steam Shoveling

Steam Shovel Practice, Llewellyn N. Edwards. Can. Engr., vol. 36, no. 2, Jan. 9, 1919, pp. 123-126, 6 figs. Factors upon which economy of operation depends; essential characteristics of efficient operator.

Tunnels

Economics of the C. N. R. Tunnel at Montreal, H. K. Wicksteed. Can. Engr., vol. 36, no. 4, Jan. 23, 1919, pp. 157-162, 5 figs. Problems in location that arose when seeking entrance into that city; observations and incidents regarding construction difficulties. Paper read before Toronto Branch Eng. Inst. Can.

See also RAILROAD ENGINEERING, Permanent Way and Buildings (Landslip)

HARBORS

Hamilton

Recent Harbor Improvement at Hamilton, John Taylor. Contract Rec., vol. 33, no. 3, Jan 22, 1919, pp. 70-72, 4 figs. Completing construction of wharf wall and reclamation of enclosed area behind it.

Quebec

Champlain Dry Dock for Quebec Harbor, U. Valiquet. Engineering, vol. 106, no. 2762, Dec. 6, 1918, pp. 658-662, 16 figs. Illustrated description from paper before Canadian Soc. of Civil Engrs.

Singapore

Recent Harbor and Dock Works at Singapore, Straits Settlements. Engineering, vol. 106, no. 2761, Nov. 29, 1918, pp 603-608, 17 figs. Account of recent developments and improvements.

ROADS AND PAVEMENTS

Bituminous Roads

Bituminous Surfaces in York County, Ont., E. A. James. Can. Engr., vol. 36, no. 3, Jan. 16, 1919, pp. 145-146. Classifies bituminous surfaces into surface mats and wearing surfaces; method followed for each is given. Paper before Ont. Good Roads Assn.

Canada

Width of Provincial Highways, W. A. McLean. Can. Engr., vol. 36, no. 2, Jan. 9, 1919, pp. 131-133, 5 figs. Road sections proposed by Ontario Deputy Minister of Public Highway.

Concrete Roads

The Construction of Concrete Roads, William W. Cox. Contract Rec., vol. 33, no. 3, Jan. 15, 1919, pp. 52-53. Notes on drainage, preparation of subgrade, selection of materials, workmanship and prospection. Paper before Mich. State Good Roads Assn.

Cracking of Concrete Roads and Its Prevention by Reinforcing with Steel, W. B. Sawyer, Jr. Cement & Eng. News, vol. 31, no. 1, Jan. 1919, pp. 28-29. Expansion of concrete by change of temperature; change in moisture content; non-uniform bearing on sub-base; expansion or contraction of sub-base due to change in moisture content; placing reinforcing steel. From Western Eng.

Drainage

Drainage Methods and Foundations for County Roads, E. W. James, Vernon M. Peirce and Charles H. Moorefield. U. S. Department of Agriculture, bul. 724, Dec. 21, 1918, 86 pp., 33 figs. Discussion of important characteristics of different kinds of soils ordinarily encountered in highway construction; proper methods of draining roadbeds constructed of various kinds of soil and under different topographic conditions; explanation of how foundations may be designed to suit soil conditions, road surface and system of drainage.

Engineers, Highway

Engineers for Highway Work, John H. Mullen. Contract Rec., vol. 33, no. 3, Jan. 15, 1919, p. 48. Inadequate pay of highway engineers; qualifications of a highway engineer. From paper before Am. Assn. State Highway Officials.

French Roads

American Methods and Machinery Applicable to Construction and Maintenance of French Highways, Arthur H. Blanchard. Mun. Jl., vol. 46, no. 2, Jan. 11, 1919, pp. 23-32, 16 figs. Restoring of French roads that have been worn out by traffic or destroyed by enemy.

Heavy-Traffic Roads

Notes on Road Construction and Maintenance, Thomas Sawyer Bower. Quarry, vol. 24, no. 263, Jan. 1919, p. 18. Author's experience in regard to securing road which will stand abnormal traffic for long periods. Abstract of paper before Instn. Civil Engrs.

Minnesota Highways

Proposed Highway System for Minnesota. Good Roads, vol. 16, no. 26, Dec. 28, 1918, pp. 249-250, 1 fig. Description of 6000-mile system of main roads proposed by State Highway Department.

National Highways

A National Highway Policy and Plan, E. J. Mehren. Am. City, vol. 20, no. 1, Jan. 1919, pp. 1-5. Plea for selection, construction and maintenance by Federal Government of a national highway system that shall embrace entire country. From address before Joint Highway Congress.

Road Corrugation

Road Corrugation, Ernest Leonard Leeming. Surveyor, vol. 54, no. 1403, Dec. 6, 1918, p. 270. Probable causes; suggestions for preventing or alleviating it. Abstract of paper before Instn. Civil Engrs. Also in Times Eng. Supp., no. 530, Dec. 1918, p. 267.

San Francisco

Street Paving in San Francisco. Mun. Jl., vol. 46, no. 1, Jan. 4, 1919, pp. 1-3, 3 figs. Basalt blocks for heavy traffic, brick for steep grades, asphalt and bituminous concrete for easy grades. Methods of constructing base and wearing surface; grading streets; cost.

Subgrade

Methods for Subgrade Testing on Street Grading Work, E. Earl Glass. Am. City, vol. 20, no. 1, Jan. 1919, pp. 47-48, 2 figs. Use of two 8-ft. rods graduated to feet and tenths from middle as zero, fitted with spikes, and having adjustable targets.

Drainage and Preparation of Subgrade. Concrete Age, vol. 29, no. 3, Dec. 1918, pp. 10-13. Report of Committee on drainage and of subgrade, Nat. Congress on Concrete Road Building.

Wisconsin Highways

Marking and Mapping the Wisconsin Trunk Line Highway System, A. R. Horst. Good Roads, vol. 17, no. 2, Jan. 11, 1919, pp. 13-15, 3 figs. From a paper entitled The Underlying Principles Controlling the Laying Out, Marking and Maintaining of a State Trunk Highway System, presented at joint session of Am. Assn. State Highway Officials and Highway Industries Assn.

SANITARY ENGINEERING

Garbage

Methods of Garbage and Rubbish Collection and Disposal in Larger Cities. Contract Rec., vol. 33, no. 2, Jan. 8, 1919, pp. 32-34. Methods followed in Baltimore, Chicago, Cincinnati, Cleveland, Kansas City, Mo., Milwaukee, Minneapolis, New York, St. Louis and St. Paul.

Sewage-Plant Operation

Instructions for the Operation of State Sewage Plants. Contract Rec., vol. 33, no. 2, Jan. 8, 1919, pp. 35-37. Bulletin prepared by Bureau of Sanitary Engineers and issued by Texas State Board of Health.

Biological Purification of City Sewage (Die Klaeranlage der staedtischen Kanalisation in St. Gallen). Schweiz. Bauzeitung, vol. 72, no. 24, Dec. 14, 1918, pp. 231-233, 6 figs. Technical description of sewage purification plant for 60,000 inhabitants. The drip system used in conjunction with a small river. (To be concluded.)

Sewer Construction

Rideau River Intercepting Sewer, Ottawa, L. McLaren. Contract Rec., vol. 33, no. 2, Jan. 8, 1919, pp. 21-24, 9 figs. Design and construction of interceptor which will drain 1060 acres.

Some Sewer Construction Details. Mun. Jl., vol. 45, no. 26, Dec. 28, 1918, pp. 501-502, 2 figs. Laying a sewer above street grade; excavating and laying sewer in deep trench in sand and water.

WATER SUPPLY

Meters

Sizes of Service Meters, W. R. Edwards. Mun. Jl., vol. 46, no. 1, Jan. 4, 1919, pp. 4-5. Practices and experience of Passaic Water Co. in use of meters, specially in regard to desirable sizes. Paper before N. Y. Section, Am. Water Works Assn.

Pipe Maintenance

Lead Pipe Couplings, J. A. Jensen. Jl. Am. Water Works Assn., vol. 5, no. 4, Dec. 1918, pp. 407-411. Examples of water loss to municipality on account of service leaks occurring between water main and meter; results of experimental examination of conditions developing leaks.

Cold Weather and Mains in Duluth. Mun. Jl., vol. 46, no. 1, Jan. 4, 1919, pp. 6-7. Experience with freezing and thawing by electricity.

Water Main Cleaning in St. Louis. Mun. Jl., vol. 46, no. 1, Jan. 4, 1919, pp. 5-6, 4 figs. Methods and results in cleaning 50 miles of mains.

Reservoirs

Waterworks Operation: Maintenance of Reservoirs. Mun. Jl., vol. 45, no. 26, Dec. 28, 1918, pp. 506-507; vol. 46, no. 1, Jan. 4, 1919, pp. 10-12. Dec. 28: Features of maintenance of small reservoirs and of large impounding reservoirs, sodding and other treatment of embankments; Jan. 4: Causes of leakage from reservoirs, their location, stopping them by use of cement, asphalt, clay, etc. (To be continued.)

Construction Methods Employed in Building the New Intake and Remodeled Reservoirs of the Oshkosh, Wis., Water Works, T. B. Jorgensen. Cement & Eng. News, vol. 31, no. 1, Jan. 1919, pp. 26-27, 3 figs. Intake consists of 300 ft. of piping connecting shore line with suction well in filtration plant, and 1200 ft. of piping from shore line out in Lake Winnebago. It is constructed of 24-in. cast-iron piping.

Water Mains, Protection of

Protecting Water Mains, Fire Hydrants and Valves Against Freezing in Winnipeg, F. H. Hooper. Contract Rec., vol. 33, no. 1, Jan. 1, 1919, p. 3. Paper before Nat. Fire Protection Assn.

Water Purification

St. Louis Water Purification Plant. Mun. Jl., vol. 45, no. 26, Dec. 28, 1918, pp. 503-505. Amounts and prices of chemical used; methods and results of operation; cleaning filter sand; effects of chemicals on apparatus; itemized cost of operating plant.

Water Storage

Advantages and Disadvantages of the Storage of Water, Melville C. Whipple. Contract Rec., vol. 33, no. 2, Jan. 1, 1919, pp. 6-7. Claims that storage of surface water affords effectual means for safeguarding its hygienic quality and indicates means to overcome increase of color and production of tastes and odors from growth of microscopic organisms.

WATERWAYS

Georgian Bay Canal

The Georgian Bay Canal, J. J. Bell. Engineer, vol. 126, no. 3286, Dec. 20, 1918, pp. 527-528, 8 figs. Description of proposed Canadian canal connecting Georgian Bay with the St. Lawrence at Montreal.

Interior Navigation

Notes in Interior Navigation of Various Countries (Apuntes sobre la navegacion interior en algunos paises), Carlos Mendoza. Revista de Obras Publicas, year 66, nos. 2256 and 2257, Dec. 19 and 26, 1918, pp. 625-630 and 637-640. Dec. 19: Economical aspect of inland water transportation and railway construction in development of present network of canals and navigable rivers in France; Dec. 26: Data on navigable courses in England, United States, Germany and Italy. (Concluded.)

Italy

The Port of Ostia Nuova, near Rome, and the Railway from Ostia to Rome (Le port d'Ostia Nuova, près de Rome et le chemin de fer d'Ostia à Rome). Génie Civil, vol. 74, no. 1, Jan. 4, 1919, pp. 12-13, 2 figs. Project to build navigable canal connecting Rome and Ostia Nuova.

U. S. Rules for Water Transportation

Rivers. General Rules and Regulations Prescribed by the Board of Supervising Inspectors as Amended at Board Meeting of January 1918, and further Amended by Action of Executive Committee of the Board of Supervising Inspectors, Meetings of March 15, April 3, May 11, June 5, August 5, and September 24, 1918. Department of Commerce, Steamboat-Inspection Service, form 801D, Nov. 19, 1918, 145 pp. 5 figs. Concerning boilers, attachments, boats, rafts, fire apparatus, ferryboats, barges, lifeboats, steam pumps, safety valves, etc.

MUNICIPAL ENGINEERING

Town Planning

Town-Planning in New Zealand, A. G. Waller. Jl. Am. Inst. Architects, vol. 6. no. 12, Dec. 1918, pp. 567-577. Résumé of town-planning bill; conditions of trade, wealth and production in New Zealand; significance of town-planning in architectural developments.

Relation of the Curve to Town-Planning, H. L. Seymour. Can. Engr., vol. 36, no. 2, Jan. 9, 1919, pp. 119-121, 4 figs. Discussion of methods employed in laying out curves for streets or lot lines.

Mining Engineering

BASE MATERIALS

Rock Quarrying

Rock Quarrying for Cement Manufacturing, Oliver Bowles. Stone, vol. 40, no. 1, Jan. 1919, pp. 19-21, 2 figs. Efficiency and safety under modern conditions of operation. From Bureau of Mines bulletin.

COAL AND COKE

Coal Oxidation and Ignition

The Oxidation and Ignition of Coal, Richard Vernon Wheeler. Jl. Chem. Soc., vols. 113 and 114, no. 674, Dec. 1918, pp. 945-955, 2 figs. Account of work carried out during past nine years by British Coal Dust Experiments Committee, Min. Assn. Great Britain. Hypothesis is advanced that reaction responsible for self-heating of coal is mainly attachment of oxygen to molecules of high carbon content, and subsidiary to this, interaction oxygen thus loosely held, by carbon-like molecules, and other atoms or those molecules, or other portions of coal conglomerate.

Coal Production

Coal—Now and Next Year, C. E. Lesher. Coal Age, vol. 15, no. 3, Jan. 16, 1919, pp. 99-104, 4 figs. Statistics of production and consumption.

Coke-Oven Gas

Washing Light Oil Fractions from Coke Oven Gas, F. D. Schreiber. Gas Age, vol. 43, no. 1, Jan. 1, 1919, pp. 22-24, 1 fig. Suggestions from general foreman of benzol plant.

Coke Plant Producing Gas for Domestic Purposes. Gas Age, vol. 43, no. 1, Jan. 1, 1919, pp. 11-12, 3 figs. Example of by-product coking practice. Plant consists of 65 Koppers cross-regenerative ovens (12½ tons) with capacity of 1200 tons coal per day and is complete for recovery of gas, tar, ammonia and benzols.

Coke-Oven Gas and the Demand for Cheap Fuel. Gas Age, vol. 43, no. 1, Jan. 1, 1919, pp. 16-17. Extent of coke production in ovens and in beehive ovens; importance of metering gas.

Chester Producer Fired By-Product Coke Ovens, J. D. Shattuck. Gas Age, vol. 43, no. 1, Jan. 1, 1919, pp. 7-10, 6 figs. Operation of Philadelphia Gas & Elec. Co. plant for production of city gas and also for recovery of by-products.

Coke Ovens

Economic Considerations in Coke Oven Practice, W. Colquhoun. Colliery Guardian, vol. 116, no. 3020, Nov. 15, 1918, pp. 1022-1024. From paper before Midland Inst. of Civ. Min. and Mech. Engs., Nov. 1918. Also in Iron & Coal Trades Rev., vol. 97, no. 2647, Nov. 15, 1918, pp. 541-543.

Change in Beehive Coke Oven Construction Due to Mechanical Operation, George W. Harris. Coal Age, vol. 15, no. 2, Jan. 9, 1919, pp. 44-48, 12 figs. Details of coke ovens for mechanical operation.

A New Coke Oven Installation. Engineer, vol. 126, no. 3282, Nov. 22, 1918, pp. 430-432, 5 figs. Description of battery of thirty-seven 12-ton Semet-Solvay coke ovens with washer and by-product recovery plant at one of plants of Newton, Chambers & Co., Ltd.

Economic Considerations in Coke Oven Practice, W. Colquhoun. Gas World (Coking Section), vol. 69, no. 1794, Dec. 7, 1918, pp. 19-20. Deficiencies in present application of heat necessary to distil coal; advantages of hot direct-recovery process. Paper before Midland Inst. Min. Engrs.

Republic By-Product Coke Plant at Youngstown. Gas Age, vol. 43, no. 1, Jan. 1, 1919, pp. 13-15, 5 figs. Brief description of by-product coke-oven installation of 143 Koppers ovens, producing gas and coke for use in steel manufacture.

Plant of the Seaboard By-Product Coke Company, D. MacArthur. Gas Age, vol. 43, no. 1, Jan. 1, 1919, pp. 1-6, 9 figs. Oven installation consists of 165 Koppers ovens subdivided into three units. Daily capacity is 3000 tons of coal, yielding 2200 tons coke, 16½ million cubic feet surplus gas of 610 B.t.u. quality, 75,000 lb. ammonium sulphate, 24,000 gal. tar and 10,000 gal. light oil. (To be continued.)

Insulation for By-Product Coke Ovens, P. A. Boeck. Gas Age, vol. 43, no. 1, Jan. 1, 1919, pp. 24-26, 5 figs. How insulating bricks are placed in wall; heat gradient and saving due to heat insulation; advantages of insulation.

Rail Transportation

Railroad Readjustment Problems Confront Coal Operators, John Callahan. Coal Trade Jl., year 51, no. 3, Jan. 15, 1919, pp. 51-52. How mining is affected by transportation control as well as by maintenance or modifications of existing regulations.

ORE DRESSING

Tube and Ball Mills

Notes on Ore Dressing, A. W. Allen. Eng. & Min. Jl., vol. 107, no. 2, Jan. 11, 1919, pp. 100-102. Efficiency of tube mills; progress in ball-milling practice.

GEOLOGY AND MINERALOGY

Earth Movements

Earth Movements. Jl. Chem. Metallurgical & Min. Soc. S. A., vol. 19, no. 1, Oct. 1918, pp. 63-66. Analysis of probable causes which operated in movement of ground at Great Boulder mine. From Jl. Chamber of Mines of W. Australia.

Igneous Differentiation

A Type of Igneous Differentiation, Frank F. Grout. Jl. Geol., vol. 26, no. 7, Oct-Nov., 1918, pp. 626-658, 12 figs. Rocks of Duluth gabbro lopolith are found to fall into two series, one related to gabbro family, other more closely to granites.

Manganese Dioxide Banding

Rythmic Banding of Manganese Dioxide in Rhyolite Tuff, W. A. Tarr. Jl. Geol., vol. 26, no. 7, Oct-Nov. 1918, pp. 610-617, 5 figs. Explains origin of eccentric structures of manganese dioxide found near Tucson, Ariz., by manganese dioxide being derived from mineral located at nucleus of structure and being precipitated in successive rings by rhythmic precipitation following mingling of outwardly moving manganese solution with one of oxidizing character.

Radiolarian Charts

The Radiolarian Cherts of the Franciscan Group, E. F. Davis. Univ. Cal. Publications, Bul. Dept. Geol., vol. 11, no. 3, Dec. 23, 1918, pp. 235-432, 30 figs. Results of investigation to determine their origin.

Rock Diagrams

A Form of Multiple Rock Diagrams, Frank F. Grout. Jl. Geol., vol. 26, no. 7, Oct-Nov. 1918, pp. 622-625, 3 figs. Modification of Adams' method. Individual rock diagrams are not plastered but clamped into position leaving them free for rearrangement as they are studied from various points of view.

Tear Figures and Minerals

Tear-Figures on Certain Minerals, Mikio Kuhara. Memoirs College of Eng., Kyoto Imperial Univ., vol. 2, nos. 2 and 3, July and Nov. 1918, pp. 53-62 and 71-82, 45 figs. July: Characteristics on tear-figures on aragonite, alum and borax; Nov.: Characteristics on tear-figures on minerals belonging to tetragonal and triclinic systems, wulfenite and copper-sulphate crystals were selected as representatives of these systems.

IRON

Belcher Islands' Deposits

Iron Deposits on the Belcher Islands, Hudson Bay, E. S. Moore. Monthly Bul. Can. Min. Inst., no. 82, Feb. 1919, pp. 196-206, 4 figs. Topographic features and geology; photomicrographs of granules from iron field; results of analysis of sample.

Production

World's Division of Iron Analyzed, A. J. Hain. Iron Trade Rev., vol. 64, no. 1, Jan. 2, 1919, pp. 28-32, 3 figs. Pig-iron and steel production in United States, United Kingdom, France and Germany for years 1913-1918.

COPPER

Kennecott District

Mining Copper at Kennecott, Alaska. Min. & Sci. Press, vol. 118, no. 2, Jan. 11, 1919, pp. 53-56, 3 figs. Mining possibilities.

Mineral Determination

Sulphur Dioxide Method for Determining Copper Minerals in Partly Oxidized Ores, Charles E. Van Barneveld and Edmund S. Leaver. Department of Interior, Bur. of Mines, tech. paper 198, 14 pp., 1 fig. Sources of error in sulphuric acid method and ammonia method for selective determination of copper minerals; procedure in sodium tartrate method; sulphur dioxide method; results of leaching chalcocite and chalcopyrite with 5 per cent solution of different reagents; results with four methods compared.

Utah

The Utah Copper Enterprise—IX, T. A. Rickard. Min. & Sci. Press, vol. 117, no. 26, Dec. 28, 1918, pp. 853-860, 9 figs. Smelting of concentrate at Garfield smelter of Am. Smelting & Refining Co.

LEAD

Hydrometallurgy

Innovations in the Metallurgy of Lead, Dorsey A. Lyon and Oliver C. Ralston. Department of Interior, Bur. of Mines, bul. 157, 1918, 176 pp., 13 figs. Application of new hydrometallurgical and other methods. Results of experiments conducted by Salt Lake City station of Bur. of Mines in coöperation with department of metallurgical research, Univ. of Utah.

Smelting

Metallurgy of Lead, H. O. Hofman. Eng. & Min. Jl., vol. 107, no. 2, Jan. 11, 1919, pp. 88-90. Lead smelting practice; modern silver-lead smeltery.

MAJOR INDUSTRIAL MATERIALS

Manganese

Electric Smelting on the Pacific Coast, W. L. Morrison. Jl. Elec., vol. 42, no. 2, Jan. 15, 1919, pp. 67-68. States that while absence of cheap power precludes general development of electric furnace, nevertheless there is real opportunity in electric smelting of silicon manganese.

Metallurgical Investigations During 1918, Van H. Manning. Blast Furnace, vol. 7, no. 1, Jan. 1919, pp. 65-67. Production of ferromanganese; smelting low-grade manganese ores in electric furnace; use of low-grade iron; problems studied by Bureau of Mines.

Manganese Deposits of East Tennessee—II, G. W. Stose and F. C. Schrader. Resources of Tennessee, vol. 8, no. 4, Oct. 1918, pp. 235-324, 14 figs. Report prepared under coöperative agreement between State Geol. Survey and U. S. Geol. Survey.

Nickel

A Process for Electrolytically Refining Nickel, Geo. A. Guess. Gen. Meeting Am. Electrochem. Soc., Apr. 3-5, 1919, advance copy, paper 2, pp. 9-12. Impure nickel containing copper and iron is used as anode; both iron and copper go into solution, but copper is precipitated by keeping powdered calcium carbonate suspended in electrolyte; cathode is enclosed in canvas bag; glue is used in solution.

Zinc

Metallurgy of Zinc, W. E. Ingalls. Eng. & Min. Jl., vol. 107, no. 2, Jan. 11, 1919, pp. 87-88. Roasting; distillation furnaces; distilling practice.

Foreign Zinc-Smelting Capacities and Prospects, W. R. Ingalls. Eng. & Min. Jl., vol. 107, no. 5, Feb. 1, 1919, pp. 227-228. Refers particularly to England, Australia, Belgium and Silesia.

MINES AND MINING

Cars, Mine

Standardization of Mine Cars in Metal Mines, R. M. Raymond. Eng & Min. Jl., vol. 107, no. 5, Feb. 1, 1919, pp. 220-224, 9 figs. Paper read at Seventh Annual Safety Congress, Nat. Safety Council.

Cement Gun

Use of the Cement Gun in a Bituminous Coal Mine, M. S. Sloman. Mine & Quarry, vol. 11, no. 1, Nov. 1918, pp. 1092-1095, 2 figs. Results of United Coal Corporation said to prove that a cement coating properly applied will form permanent barrier to action of weathering on roofs susceptible to air slacking; gives cost figures.

Drilling

The Technique of Diamond-Drilling, J. A. MacVicar. Min. Mag., vol. 20, no. 1, Jan. 1919, pp. 1825. History and utility of the diamond-drill; patent specifications of Leschot diamond-drilling apparatus; operations followed in process of drilling; recent uses of diamond-drills in testing of foundations for dam sites. Paper read before Cornish Inst. Engrs.

Hammer Drills—Their History, Design and Operation, Henry S. Potter. Jl. S. A. Instn. Engrs., vol. 17, no. 405, Nov.-Dec. 1918, pp. 68-80, 17 figs. Refers especially to the popular jack hammer type. (To be concluded.)

The Hand Hammer Drill, James P. Cotter. Monthly Bul. Can. Min. Inst., no. 82, Feb. 1919, pp. 207-211. Purpose in applying water and air to bottom of drill hole while drilling; uses of hammer drill in coal mines.

Hydraulic Stowing

Primary Considerations in Hydraulic Stowing, C. A. John Hendry. Colliery Guardian, vol. 116, no. 3016, Oct. 18, 1918, pp. 805-807, 14 figs. From paper before Geol. and Min. Soc. of India.

Inspection, Idaho

Mining in Idaho in 1918, R. N. Bell. Eng. & Min. Jl., vol. 107, no. 5, Feb. 1, 1919, pp. 236-238. Account of State inspection of mines.

Laws

Collection of Laws, Decrees, Resolutions and Other Acts Concerning Mines, Quarries, Sources of Mineral Waters, Steam Apparatus and Railroad Exploitation (Recueil de lois, décrets, arrêtés et autres actes concernant les mines, les carrieres, les sources d'eaux minerales, les appareils à vapeur et l'exploitation des chemins de fer). Annales des Mines, Partie Administrative, series 11, vol. 7, 1918, pp. 81-185. Documents of second quarter of 1918 issued by Ministry of Public Works, France.

Prospecting

Hydraulic Prospecting at the Rooiberg Tin Mines, E. R. Schoch. Jl. S. A. Instn. Engrs., vol. 17, no. 4-5, Nov.-Dec., 1918, pp. 61-67, 9 figs. Surface prospecting by means of hydraulic jets or monitors on level ground with artifically conserved return water.

Utah

Mining in Utah in 1918, Edward R. Zalinski. Eng. & Min. Jl., vol. 107, no. 4, Jan. 25, 1919, pp. 178-183.

1918 British Columbia

Mining in British Columbia in 1918, Robert Dunn. Eng. & Min. Jl., vol. 107, no. 2, Jan. 11, 1919, pp. 110-111.

1918 U. S.

General Review of Mining in the United States in 1918. Eng. & Min. Jl., vol. 107, no. 2, Jan. 11, 1919, pp. 103-107.

See also MECHANICAL ENGINEERING, Handling of Materials (Coal Handling, Coke.)

MINOR INDUSTRIAL MINERALS

Graphite

Alabama Graphite in 1918, W. F. Prouty. Eng. & Min. Jl., vol. 107, no. 4, Jan. 25, 1919, pp. 194-195. Processes in milling; classification of washers; costs.

Monazite

Monazite as a Source of Incandescent Lighting Material, Sydney J. Johnstone. Gas World, vol. 69, no. 1794, Dec. 7, 1918, pp. 350-351. Sources and history of mineral monazite from which are obtained the rare earths composing luminous portion of incandescent gas mantle. From Jl. Soc. Chem. Indus.

Molybdenum

Molybdenum Within the Empire, Sydney J. Johnstone. Jl. Soc. Chem. Indus., vol. 37, no. 23, Dec. 16, 1918, pp. 448R-450R. Statistics of world production and particularly of progress in mines throughout British Empire.

Tungsten

The Tungsten Industry in 1918, Geo. J. Young. Eng. & Min. Jl., vol. 107, no. 2, Jan. 11, 1919, pp. 78-80. Difficulties of mining; inconvenience of not having standard specifications for buying tungsten ores; domestic and total world production figures.

Tungsten and the War, Julius L. F. Vogel. Min. Mag., vol. 20, no. 1, Jan. 1919, pp. 12-17. Qualities possessed by high speed tungsten steel; development of tungsten industry in Great Britain; manufacture of tungsten.

The Occurrence, Chemistry, Metallurgy and Uses of Tungsten, with Special Reference to the Black Hills of South Dakota, J. J. Runner and M. L. Hartmann. South Dakota School of Mines, bul. 12, Departments of Geol. & Chem., Sept. 1918, pp. 1-159 and 257-262, 20 figs. Parts relating to deposits of Black Hills are the result of field work and laboratory research of authors.

A Bibliography of Tungsten Mines, Louis Hartmann. South Dakota School of Mines, bul. 12, Departments of Geol. & Chem., Sept. 1918, pp. 160-255 and 262-264.

Tungsten and Molybdenum

Manufacture of Tungsten and Molybdenum, Paul McJunkin. Am. Mach., vol. 50, no. 3, Jan. 16, 1919, pp. 99-100, How tungsten wire is made; coiling the spiral; properties; applications; use of tungsten disks in wireless apparatus; development of X-ray; tungsten wire data.

Vanadium

Analysis of Vanadium in the Ferrovanadiums (Método de valoración del vanadio en los ferrovanadios), Vicente Garcia Rodeja. Boletin de Minas, vol. 10, nos. 7-9, Sept. 30, 1918, pp. 122-128. Survey of methods in use; special reference to Slavig method by treatment with nitric and hydrochloric acids; fusion method of Pinerúa (reagent is sodium bioxide).

OIL AND GAS

Crude Oil Production

Production of Crude Oil at New High Level. Automotive Industries, vol. 40, no. 3, Jan. 16, 1919, pp. 154-157, 2 figs. Exports of all mineral-oil products except kerosene show steady increase for 21 years.

The Passing of Petroleum. Engineering, vol. 106, no. 2762, Dec. 6, 1918, pp. 633-635, 3 figs. Review of present situation.

Petroleum — A Resource Interpretation, Chester G. Gilbert and Joseph E. Pogue. Jl. Soc. Automotive Engrs., vol. 4, no. 2, Feb. 1919, pp. 100-110, 4 figs. Discussion of available resources and their conservation.

Gasoline

Making Gasoline from Gas. Motor Boating, vol. 23, no. 1, Jan. 1919, pp. 13-14 and 47, 2 figs. General arrangement of apparatus employed in process of recovering gasoline from casing-head gas.

Determining Gasoline in Natural Gas, W. P. Dykema and Roy C. Neal. Automotive Industries, vol. 40, no. 2, Jan. 9, 1919, pp. 57-59, 2 figs. Method evolved at Bartlesville Experiment Station, Bureau of Mines.

Testing Gas for Its Gasoline Content, W. P. Dykema and Roy C. Neal. Oil and Gas Jl., vol. 17, no. 32, Jan. 10, 1919, pp. 42 and 44, 2 figs. Absorption apparatus developed by Bureau of Mines experts.

Mexico

Mexico as a Source of Petroleum and Its Products, R. De Golyer. Jl. Soc. Automotive Engrs., vol. 4, no. 2, Feb. 1919, pp. 74-76. Estimates of reserves in Mexican oil fields; development since 1910; present conditions.

Oil Recovery

Production of Oil from Mineral Sources, F. Mollwo Perkin. Gas Jl., vol. 144, no. 2902, Dec. 24, 1918, pp. 658-660. When to use high or low temperature for carbonizing bituminous material. Paper read before Instn. Petroleum Technologists.

Petroleum Industry

Some General Observations on the Petroleum Industry, V. H. Manning. Jl. Soc. Automotive Engrs., vol. 4, no. 1, Jan. 1919, pp. 35-38, 2 figs. Coöperation between Bur. of Mines and petroleum industry; possible technical research work; utilization of oil shales; foreign supply situation. From address by Director, Bur. of Mines, before Reconstruction Conference of Indus. War Service Committees.

Shale

Commercial Possibilities of Oil Shale, Harry J. Wolf. Eng. & Min. Jl., vol. 107, no. 5, Feb. 1, 1919, pp. 217-219, 2 figs. Oil-bearing shales in Colorado and Utah and their present development; methods of mining and milling, comparison with Scottish shale deposits.

Water, Shutting Off

Methods of Shutting Off Water in Oil and Gas Wells, F. B. Tough. Department of Interior, Bur. of Mines, bul. 163, 122 pp., 27 figs. Summarizes existing knowledge of methods and devices for protecting oil or gas sands from encroachment of water; California laws relating to protection of natural resources of petroleum and natural gas flow. Also in Water & Gas Rev., vol. 29, no. 7, Jan. 1919, pp. 28-29.

One of the Problems Involved in Excluding Water from Oil or Gas Wells, F. B. Tough. Water & Gas Rev., vol. 29, no. 7, Jan. 1919, pp. 28-29. Making watertight joint between string of casing and wall of hole at impervious stratum above productive sands and below water horizons; formulæ for collapsing pressures of modern lay-welded bessemer-steel tubes.

PRECIOUS MINERALS

Gold

The Value of Gold in the Economic System, Henry Strakosch. Min. & Sci. Press, vol. 117, no. 26, Dec. 28, 1918, pp. 861-863. Classifies gold mines and suggests means for stimulating production of gold.

The Gold Problem. Min. Mag., vol. 20, no. 1, Jan. 1919, pp. 28-31. Report of the British Government committee, appointed to investigate problem of maintaining output of gold in face of increasing costs at mines.

Coal Saving by the Scientific Control of Steam Boiler Plants*

By D. Brownlie

THE author has been associated for about ten years with the investigation on scientific lines of the working of every description of steam-boiler plant, and in the present article it is proposed to give the average figures for 250 typical steam boiler plants, with the object of supplying accurate data as to the tremendous national economy that can be effected by the adoption of scientific methods in the boiler-house.

In the burning of coal for the generation of steam, the loss because of lack of scientific methods is hardly realized and, apart from the national point of view, offers to the individual firm a means of most substantial economy in running expenses.

Economizers.—Out of the 250 plants, 155 were fitted with economizers, the other 95 plants having no means of utilizing the waste heat from the boiler flues.

Taking the 155 plants fitted with economizers, the average saving is 11.4 per cent. of the coal bill. The highest figure found was 19 per cent. on a cotton-mill plant. The ordinary figure obtained on a well-managed plant is 15 to 20 per cent. saving, depending on the conditions.

Power
December 3, 1918

Engineers sometimes question the claims of the manufacturers regarding the savings made by their apparatus.

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Gold and Silver

Metallurgy of Gold and Silver, A. W. Allen. Eng. & Min. Jl., vol. 107, no. 2, Jan. 11, 1919, pp. 92-96. Amalgamation practice; reinstatement of charcoal as precipitant; South African metallurgical progress; gold extraction with colloidal carbon; refining gold bullion; sodium sulphide in cyaniding.

RARE MINERALS

Radium

How Radium-Bearing Ore Is Mined, Wallace T. Roberts. Min. & Sci. Press, vol. 118, no. 1, Jan. 4, 1919, p. 30, 3 figs.; Mine & Quarry, vol. 11, no. 1, Nov. 1918, pp. 1106-1110, 8 figs. Nov.; Prospecting carnotite areas in Colorado; Jan. 4: Methods of prospecting followed by Colorado companies.

Radium: Its Properties and Occurrence in Nature—II, Richard B. Moore. Metal Rec. & Electroplater, vol. 4, no. 11, Dec. 1918, pp. 391-393. History of metal; location of principal ores and method of working each; present uses and future possibilities; mesothorium as substitute.

New Minerals

Review of New-Mineral Species (Revue des espèces minérales nouvelles), P. Gaubert. Bulletin de la Société Française de Minéralogie, vol. 41, nos. 4-5-6, Apr-June 1918, pp. 93-96. Occurrences of crestmoreite, riverdsideite, katoptrite, ektropite, and flokite, pp. 117-130. Occurrences of crandallite, leifite, griffithite, mullanite, tetarkaite, didymolite, angaralite, arseno-bismite, arseno-ferrite, heliodore, creedite, sulphated cancrinite, cebollite, pintadoite, uvanite, hogbomite, minasragrite, aurobismuthinite, stibiobismuthinite.

Uncommon Ores

Uncommon Ores and Metals, H. C. Meyer. Eng. & Min. Jl., vol. 107, no. 2, Jan. 11, 1919, pp. 124-125. Uses and demand of palladium, selenium, strontium ore, thorium ore, titanium, uranium and zirconium.

TIN

Conservation

Symposium on the Conservation of Tin. Metal Rec. & Electroplater, vol. 4, no. 11, Dec. 1918, pp. 387-390 and 403. Methods by which tin can be saved and its use reduced; tin alloys; bearing metals, soldiers, babbitts, bronzes and their substitutes.

VARIA

Laws, Mining

Mining Law and Economics. Minerals, Mines and Quarries, David Bowen. Quarry, vol. 24, no. 263, Jan. 1919, pp. 5-7. Review of authoritative definitions of mineral, ore, mine and quarry with reference to English and continental European legal decisions establishing scope of signification.

Minerals, International Control

International Control of Minerals, C. K. Leith. Department of Interior, U. S. Geol. Survey, Mineral Resources of U. S., 1917—part 1, Dec. 31, 1918, pp. 7a-16a. Movement of minerals under pre-war conditions of international trade; possibility of post-war international control; specific plans of international control of minerals; position of U. S.; general conclusions from standpoint of U. S.

Production, U. S. for 40 Years

40 Years of Domestic Metal Production. Automotive Industries, vol. 40, no. 3, Jan. 16, 1919, pp. 180-181, 2 figs. Steady increases shown throughout last 50 years; efforts being made to increase production.

Metallurgy

ALUMINUM

Alloys

Aluminum and Its Light Alloys—IV, Paul D. Merica. Metal Rec. & Electroplater, vol. 4, no. 11, Dec. 1918, pp. 384-386. Importances of these light-weight metals for motor and aircraft construction; metallography of commercial aluminum; chemical and physical properties at high and low temperatures; tensile properties of zinc-aluminum alloys. (To be continued.)

Analysis

The Analysis of Aluminum Alloys and Metallic Aluminum, J. J. Fox, E. W. Skelton and F. R. Ennos, Jl. Soc. Chem. Indus., vol. 37, no. 24, Dec. 31, 1918, pp. 328T-333T. Methods writers have found suitable for general work. Reagents used are a 10 per cent solution of pure sodium hydroxide, and nitro-sulphuric acid made by mixing 300 cc of concentrated sulphuric acid with 300 cc of water, cooling, and adding 200 cc of pure nitric acid.

Analysis of Hard Aluminum Alloys (Analyse des alliages durs d'aluminium), A. Travers. Chimie & Industrie, vol. 1, no. 7, Dec. 1, 1918, pp. 708-711. Methods in use at Creusot works for quantitative analysis of zinc, aluminum, magnesium and copper in light alloys.

Dust, Inflammability of

The Inflammability of Aluminum Dust, Alan Leighton. Department of Interior, Bur. of Mines, Tech. Paper 152, 15 pp. Review of available literature; experimental work; properties affecting explosibility; precautions to be observed.

Metallography

The Metallography of Aluminum, Robert J. Anderson. Jl. Franklin Inst., vol. 187, no. 1, Jan. 1919, pp. 1-47, 65 figs. Discussion of amorphous theory and plastic deformation; observations on grain-growth phenomena; micrographs of various forms of aluminum, cast, worked, and annealed; annealing and recrystallization of aluminum which has undergone plastic deformation; experimental investigation of exaggerated grain growth in aluminum; process of polishing and etching aluminum microsections preparatory to microscopic examination.

BLAST FURNACES

Car Dumper

Movable Car Dumper with Rotary Cradle, A. F. Case. Blast Furnace, vol. 7, no. 1, Jan. 1919, pp. 60-61, 2 figs. Machine located near storage yard for handling ore and limestone at blast-furnace plant. Said to be capable of unloading 30 to 35 cars an hour.

Gas Operation

Blast Furnace Plant Blows in First Stack. Blast Furnace, vol. 7, no. 1, Jan. 1919, pp. 50-56, 6 figs. Installation of combined blast-furnace gas and chain-grate stokers firing on heavy mill loads. Gas cleaning designed to keep both stoves and washer clean and in operation throughout entire blast.

Potash

Potash Content of Blast Furnace Charges, N. H. Gellert. Iron Age, vol. 103, no. 6, Feb. 6, 1919, pp. 355-356. Alabama iron ores and foreign manganese ores contain the most; potash in the burden of American furnaces.

Slag

Widening Demand for Blast Furnace Slag, Clarence E. Wright. Iron Age, vol. 103, no. 4, Jan. 23, 1919, pp. 241-243, 5 figs. Uses to which it has been put; a possible $20,000,000 income to industry.

Thickener

Dorr Thickener in Blast-Furnace Field. Iron Age, vol. 103, no. 2, Jan. 9, 1919, pp. 112-115, 3 figs. Used in clarification of washer discharge water it eliminates troublesome problems and yields valuable product; simplicity of operation.

COPPER

Boron Deoxidizer

The Boronic Deoxiding of Copper, James Scott. Foundry Trade Jl., vol. 20, no. 203, Nov. 1918, pp. 598-599, 3 figs. Experimental research of procedure followed by boronic compounds when acting on copper and its alloys.

Bronze Heat Treatment

Effect of Heat Treatment on Bronze, F. F. Hausen and O. A. Knight. Iron Age, vol. 103, no. 6, Feb. 6, 1919, pp. 347-349, 12 figs. Characteristics disclosed by Brinell hardness tests and photomicrographs; quenching and drawing give greater hardness than quenching alone.

Bronze Inclusions

Nonmetallic Inclusions in Bronze and Brass, G. F. Comstock. Foundry, vol. 47, no. 318, Feb. 1919, pp. 79-83, 21 figs. From a paper presented at the October meeting of the Institute of Metals Division of the Am. Inst. of Min. Engrs.

Heap Leaching

Metallurgy of Copper, Arthur L. Walker. Eng. & Min. Jl., vol. 107, no. 2, Jan. 11, 1919, pp. 90-92. Heap-leaching experiments being conducted in southwestern copper centers; Anaconda fume-dust collector.

FERROALLOYS

Production

Ferroalloys Production Stimulated. Iron Trade Rev., vol. 64, no. 1, Jan. 2, 1919, pp. 118 and 120. Imports and domestic production of manganese alloys; imports of manganese ore; stimulation in production of spiegeleisen.

1918

Ferro-Alloys in 1918, Robert J. Anderson. Eng. & Min. Jl., vol. 107, no. 2, Jan. 11, 1919, pp. 83-86. Technical advances in metallurgical processes.

FLOTATION

Flotation Machines

The Flotation Process, A. W. Allen. Eng. & Min. Jl., vol. 107, no. 2, Jan. 11, 1919, pp. 97-100. New flotation machines; progress in selective flotation; development of Galena flotation; separate treatment of colloids.

IRON AND STEEL

Blast Furnaces

See preceding column.

Case-Hardening

Ancient and Modern Carbonizing Methods, Theodore G. Selleck. Am. Drop Forger, vol. 5, no. 1, Jan. 1919, pp. 7-12, 4 figs. Discusses use of compounds for case-hardening and describes improved methods. Uniform results secured by preheating.

Chrome Steel

Physical Qualities of High Chrome Steel, L. R. Seidell and G. J. Horvitz. Iron Age, vol. 103, no. 5, Jan. 30, 1919, pp. 291-294, 4 figs. Relation between hardness and double carbides in solution; critical temperatures; maximum tensile strength and ductility.

Density

Specific Density of Steel, H. E. Roerr. Iron Age, vol. 103, no. 3, Jan. 16, 1919, p. 184, 1 fig. Extent to which forging compresses or consolidates metal. From paper for Feb. meeting of Am. Inst. of Min. Engrs., New York.

Furnaces

Pulverized Coal for Metallurgical Furnaces, Charles E. Longenecker. Iron Age, vol. 103, no. 6, Feb. 6, 1919, pp. 351-352, 1 fig. Greater efficiency claimed for furnaces of correct design; continuous service more certain; average combustion figures for different furnace types.

Germany

The Future of the German Iron Industry, H. Müngesheimer. Cassier's Eng. Monthly, vol. 54, no. 6, ec.D 1918, pp. 340-341. Opinion of General Director of Gelsenkirchen Steel and Iron Works.

Heat Treatment and Grain Size

Grain Limits in Heat-Treated Alloy Steels, R. S. Archer. Iron Age, vol. 103, no. 6, Feb. 6, 1919, pp. 266-367, 12 figs. New etching process which defines the crystals, boundaries and assists in detecting faulty heat treatment. From paper for February meeting of American Institute of Mining Engineers, New York.

High-Speed Steel

Durability of High Speed Steels, R. Poliakoff. Iron Age, vol. 103, no. 5, Jan. 30, 1919, pp. 295-296, 2 figs. Russian cutting tests with nine brands; chemical composition and requirements; results compared with Taylor's conclusions.

Hot Deformation of Steel

Influence of Hot Deformation on Steel, George Charpy. Am. Drop Forger, vol. 4, no. 12, Dec. 1918, pp. 482-488, 3 figs. Technical discussion on effect of rolling and forging on structure of steels; data concerning changes on exterior and interior of forgings. From paper presented before Iron & Steel Inst.

Literature for 1918

Review of Iron and Steel Literature for 1918, E. H. McClelland. Blast Furnace, vol. 7, no. 1, Jan. 1919, pp. 73-75. Classified list of important books, serials and trade publications.

Molybdenum Steel

Molybdenum-Steel Versus Gun Erosion, Masatosi Okôchi, Massaichi Majima and Naoshi Sato. Jl. College of Eng., Tokyo Imperial Univ., vol. 9, no. 5, Oct. 15, 1918, pp. 153-195, 50 figs. Experimental determination of modulus of elasticity, modulus of rigidity, Brinell hardness number, thermal dilatation, thermal conductivity and magnetization at high temperatures of specimens of gun steel, nickel steel, nickel-molybdenum steel and tungsten steel.

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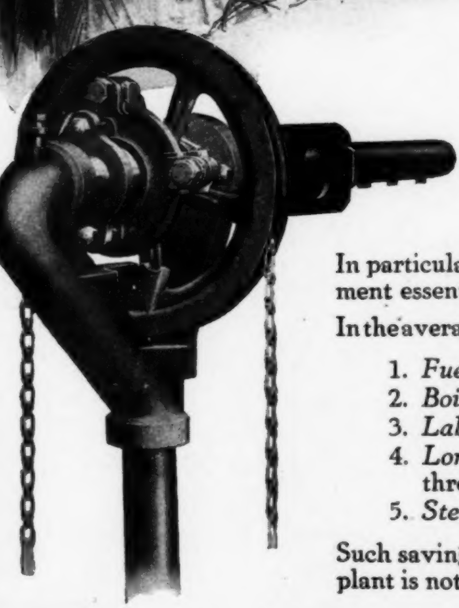

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Phosphorus

Effect of Phosphorous in Soft Acid and Basic Open Hearth Steels, J. S. Unger. Proc. Steel Treating Research Soc., vol. 2, no. 1, 1919, pp. 11-23, 11 figs. None of the steels used in experiments showed brittleness under cold working, due to phosphorus. Results of various mechanical tests, cold bending of rivets under hammer, upsetting in making barrels, automobile parts and cream separator large-headed nails or rivets, or fabrication of bowls, indicated increase of hardness with increase of phosphorus.

Phosphorus in Malleable Cast Iron, J. H. Teng. Iron & Steel Can., vol. 1, no. 11, Dec. 1918, pp. 445-453, 7 figs. Effects of proportions of phosphorus varying from 0.05 to 0.5 per cent on mechanical properties of malleable cast iron. Writer concludes that ill effects become marked at 0.2 per cent. Paper presented before Iron & Steel Inst., Sept. 1918.

Refractories

See Refractories, under MECHANICAL ENGINEERING.

Rolling and Grain Size

The Grain Size in Steel as Influenced by Rolling, W.G. Dauncey. Monthly Bul. Can. Min. Inst., no. 82, Feb. 1919, pp. 164-166, 4 figs. Photomicrographs of portion of rolled basic steel bar.

Rolling Mills

See Mechanical Processes (Plate Mills), under MECHANICAL ENGINEERING.

Steel Failures

The Cause and Mechanism of Steel Failures, Z. W. Zimmerschied. Proc. Steel Treating Research Soc., vol. 2, no. 1, 1919, pp. 24-25 and 28-29. Analysis of reasons for usual failures of automobile parts.

Steel Industry in 1918

General Review of Steel Industry for 1918, B. E. V. Luty. Blast Furnace, vol. 7, no. 1, Jan. 1919, pp. 62-65. Quantity and character of output; alignment of belligerents; labor and wages; necessity of labor-saving machinery.

Tests

Tension, Impact and Repeated Impact Tests of Mild and Hard Steels, Tsuruzo Matsumura. Memoirs College of Eng., Kyoto Imperial Univ., vol. 2, no. 2, July 1918, pp. 63-69, 16 figs. Experiments on six flat bars varying in percentage of carbon from 0.102 to 0.65, to detect cause of unexplained fractures.

NON-FERROUS ALLOYS

Stellite

Stellite—Its Manufacture and Uses. Can. Mfr., vol. 39, no. 1, Jan. 1919, pp. 77-78, 2 figs. How it is manufactured at Deloro, Ont.

Welding

Behavior of Non-Ferrous Metals Under the Oxy-Acetylene Torch—II, J. F. Springer. Metal Rec. & Electroplater, vol. 4, no. 11, Dec. 1918, pp. 381-383. How copper alloys are welded; process when working with magnesium, nickel, silver, gold, lead, tin and zinc.

Zinc Alloys

Zinc Alloys Instead of Copper Alloys. Iron Age, vol. 103, no. 3, Jan. 16, 1919, p. 175. French experiments on certain combinations of zinc, aluminum and copper as cast, rolled or drawn under a press.

See also ELECTRICAL ENGINEERING, Electrodeposition.

OCCLUDED GASES

Reactions

Notes on the Occlusion of Gases in Metals, Alfred W. Porter. Chem. Engr., vol. 26, no. 13, Dec. 1918, pp. 499-500 and 509, 1 fig. Phases of reactions between gases and metals as determined by various experimenters.

Aeronautics

AEROPLANE PARTS

Starters

The Bijur Airplane Engine Starter. Aviation, vol. 6, no. 1, Feb. 1, 1919, pp. 33-34, 3 figs. Characteristics of starter designed with minimum weight and low current consumption combined with maximum of cranking power to break away a stiff engine. It is used particularly on seaplanes.

Bijur Starters for Seaplanes and Blimps. Automotive Industries, vol. 40, no. 2, Jan. 9, 1919, p. 51, 3 figs. Fitted to Liberty engines at propeller end and crank engine through double-reduction gear with Bijur automatic screw shift.

AEROSTATICS

Airship Possibilities

The Case for the Airship, W. Lockwood Marsh. Aviation, vol. 5, no. 11, Jan. 1, 1919, pp. 697-699. Salient features and adaptabilities of lighter-than-air and of heavier-than-air craft.

Future of the Helium Airship, Ladislas d'Orcy. Aviation, vol. 5, no. 11, Jan. 1, 1919, pp. 695-697, 2 figs. How helium was produced; military aspects of discovery.

See also INDUSTRIAL TECHNOLOGY, Helium.

AIRCRAFT PRODUCTION

Naval Aircraft Factory

The Naval Aircraft Factory, Aviation, vol. 6, no. 1, Feb. 1, 1919, pp. 28-30, 7 figs. Site, dimensions and internal organization; naval flying boats.

The Naval Aircraft Factory. Mech. Eng., vol. 41, no. 2, Feb. 1919, pp. 142-146, 14 figs. Organization of staff and working force; employment of women; operation of the various departments; features of standardized seaplane manufacture at the plant.

APPLICATIONS

American View

The Opportunity of Aviation, William B. Stout. Jl. Soc. Automotive Engrs., vol. 4, no. 1, Jan. 1919, pp. 39-41 and (discussion) pp. 41-42. Difficulties to be overcome; engine development in the war; problem of landing; cost of production.

British View

Lord Weir on the Future of Flying. Flight, vol. 11, no. 1, Jan. 2, 1919, pp. 16017. Measures upon which development of operational side of air transport depends and part the State is to play in this development.

Commercial Aeronautics

Problems of Commercial Aeronautics, G. Lepere. Aviation, vol. 5, no. 11, Jan. 1, 1919, p. 694. Commercial uses of existing military planes; present possibilities of design.

Commercial Transport by Airplane. Aviation, vol. 6, no. 1, Feb. 1, 1919, pp. 31-32; Aeronautics, vol. 15, nos. 270 and 271, Dec. 18 and 25, 1918, pp. 577-592 and 608-638; Flight, vol. 10, nos. 50, 51, 52 and vol. 11, no. 1, Dec. 12, 19, 26, 1918 and Jan. 2, 1919, pp. 1413-1418, 1443-1445, 1465-1470, and 22-27. Report of special committee on law and policy; interim report of special committee on technical and practical questions of aerial transport; memorandum on experimental air service; business questions relating to aircraft industry and aerial services; labor; research and export education.

DYNAMICS

Aerofoil Sections

Selecting Aerofoil Sections for Speed Range, V. E. Clark. Aviation, vol. 6, no. 1, Feb. 1, 1919, pp. 20-22, 2 figs. Charts for selecting approximately best aerofoil section for speed range and to estimate speed performance to be expected in a given airplane.

Calculation of Performance

Performance of Aeroplanes, W. L. Cowley. Flight, vol. 11, no. 1, Jan. 2, 1919, pp. 13-15, 7 figs. Mathematical relations between horsepower, rate of climb and turning circle; conditions under which circular flight may be extended with greatest rapidity.

Flattening-Out of Aeroplanes

Flattening-Out of Aeroplanes After Steep Glides, Genjiro Hamabe. Memoirs College of Eng., Kyoto Imperial Univ., vol. 2, no. 1, June 1918, pp. 7-52, 8 figs. Derivation of general equations of rigid dynamics with center of gravity of aeroplane as origin; discussion of symmetric motion of aeroplane; problem of recovery from a steep dive at high speed treated by method of approximate calculation; application of approximate calculation to various cases of sharp flattening-out of a military Curtiss JN2 tractor.

PLANES

Christmas

The Christmas Strutless Biplane. Aerial Age, vol. 8, no. 19, Jan. 20, 1919, pp. 948-949, 8 figs. Struts, cables and wires are entirely eliminated in machine reported to make 170 miles an hour with a 6-cylinder Liberty motor.

German Planes

The Trend of German Aeroplane Design. Engineer, vol. 127, no. 3289, Jan. 10, 1919, pp. 25-26. From a report issued by the Aircraft Production (Technical Department), Ministry of Munitions.

Halberstadt

Report on the Halberstadt Two-Seater Type C. L. IV. Aeronautics, vol. 15, no. 269, Dec. 11, 1918, pp. 550-552, 12 figs; Flight, vol. 10, no. 50, Dec. 12, 1918, pp. 1404-1407, 12 figs. Biplane equipped with 180-hp. Mercedes engine; carries one fixed and one movable gun. Similar to C. L. II type. Issued by Technical Department, Aircraft Production, Ministry of Munitions.

Loening

The Loening Two-Seater Fighting Monoplane. Aviation, vol. 5, no. 11, Jan. 1, 1919, p. 689, 1 fig. Brief description of simplified type of fighting airplane designed to facilitate production.

L. V. G.

The L. V. G. Two-Seater Biplanes. Engineer, vol. 126, nos. 3284 and 3286, Dec. 6 and 20, 1918, pp. 483-486 and 525-527, 26 figs. and 17 figs.; Flight, vol. 10, nos. 51 and 52, Dec. 19 and 26, 1918, pp. 1426-1431 and 1457-1461, 20 figs.; Aeronautics, vol. 15, no. 267, Nov. 27, 1918, pp. 496-503, 48 figs. Engineer, Dec. 6: Description and illustrations of details of construction; Flight, Dec. 19: C. V. and C. VI. types; Dec. 26: Wing construction, struts, ailerons, undercarriage controls, engine mounting, oil system, accessories. Issued by technical Dept., Aircraft Production, Ministry of Munition; Aeronautics, Nov. 27, C. V. and V. I. types. Report of Technical Department of Air Ministry.

Martin

The Martin Twin-Engined Bomber, Donald W. Douglas. Aviation, vol. 5, no. 11, Jan. 1, 1919, pp. 677-680, 9 figs. Machine built to fulfill requirements of night bomber, day bomber, long-distance photography, and gun machine.

Pfalz

Report on the Pfalz (D xii) Single-Seater Fighter. Aeronautics, vol. 15, no. 269, Dec. 11, 1918, pp 544-549, 19 figs. Biplane equipped with 180-hp. Mercedes engine; carries two Spandau fixed guns. By technical Department, Aircraft Production, Ministry of Munitions.

Standard C-1

The Standard C-1 Single Seater. Aerial Age, vol. 8, no. 20, Jan. 27, 1919, pp. 985-987, 6 figs. Characteristics of Standard Aero Corporation biplane designed as secondary training machine.

ENGINES

Altitudes

Performance of Aeronautic Engines at High Altitudes, H. C. Dickinson. Aeronautics, vol. 15, no. 269, Dec. 11, 1918, pp. 542-543, 3 figs. Describes a laboratory building where it is contemplated to study engine performance in general, including carburation, under conditions corresponding to highest altitudes reached by aviators.

Carburation

Carbureting Conditions Characteristic of Aircraft Engines. Jl. Soc. Automotive Engrs., vol. 4, no. 1, Jan. 1919, pp. 9-12, 9 figs. Tests to determine changes in engine performance with changes in atmospheric temperature and pressure at various levels above earth's surface, with special reference to variables affecting functioning of carburetor and changes in performance resulting from variables in carburetor itself. From Bur. of Standards report no. 10 on aeronautic power plants.

Curtiss

The Curtiss Model K 12 Cylinder Airplane Engine. Aviation, vol. 5, no. 11, Jan. 1, 1919, pp. 685-689, 7 figs. Principal features. Engine is of fixed cylinder type and consists of 12 cylinders in two groups of six each, with included angle of 60 deg.

Dusenberg

The Dusenberg Model H 850-Hp. Motor, G. Douglas Wardrop. Aerial Age, vol. 8, no. 20, Jan. 27, 1919, pp. 991-995, 12 figs. General dimensions and particulars. Motor is of 16-cylinder V type with cylinders at an angle of 45 deg.; weight of power plant with gear drive is 1575 lb.

Hispano-Suiza

The Model H, 300-Hp. Hispano-Suiza Engine, Aviation, vol. 6, no. 1, Feb. 1, 1919, pp. 23-26, 4 figs. Points in which model H differs from other Hispano-Suiza engines, and particularly with regard to lubrication.

Liberty Engine

Ignition on Liberty Engine. Motor Age, vol. 35, no. 2, Jan. 9, 1919, pp. 20-21 and 39, 10 figs. Wiring diagram; arrangement of three arms of circuit breaker; diagram of firing order. Generator-battery type; special Delco system is used.

Miller

The Miller 125-Hp. Aircraft Engine. Aviation, vol. 6, no. 1, Feb. 1, 1919, pp. 30-31, 2 figs. Features and dimensions of this four-cylinder engine.

Radio Cylinder

Fixed Radial Cylinder Engines, John W. Smith. Jl. Soc. Automotive Engrs., vol. 4, no. 1, Jan. 1919, pp. 24-26, 5 figs. Weight of power plant; reliability, durability and balancing; fuel and oil consumption; streamline mounting; cooling. Radial engine is considered as having more advantages than V type.

Specification of Engines

Complete Technical Specifications of Important American and Foreign Airplane Engines. Automotive Industries, vol. 40, no. 3, Jan. 16, 1919, Supplement, chart between pp. 134-135. Details of 37 different types as compiled by Technical Section, Division of Military Aeronautics.

MATERIALS OF CONSTRUCTION

Plywood

Plywood in Aeroplane Construction, Henry Harrison Suplee. Aerial Age, vol. 8, no. 19, Jan. 20, 1919, pp. 945-947 and 961, 7 figs. Design and construction of plywood monocoque fuselages, plywood wing ribs and fuselage taps.

MECHANICS

Stress Determination

Stress Optical Experiments, A. R. Low. Flight, vol. 10, nos. 50 and 51, Dec. 12 and 19, 1918, pp. 1409-1410 and 1435-1439, 20 figs. Dec. 12: Examples of optical observations. Dec. 19: Deflection curves for top spar calculated and observed for total loads of 10, 20, 30, 35 and 40 lb.; principle of dynamical similarity applied to deformable elastic structures. (Concluded.)

Struts

Design of Aeroplane Struts, W. H. Barling and H. A. Webb. Aeronautics, vol. 15, nos. 268 and 269, Dec. 4 and 11, 1918, pp. 521-525, and 538-541, 9 figs. Dec. 4: Analytical determination of shape which will cause strut, when endload rises and it deflects, to be subjected to the same maximum stress at every section; Dec. 11: Mathematical theory and formulae, numerical examples, crinkling stress of steel tubes. Paper read before Roy. Aeronautical Soc.

An Approximate Graphical Treatment of Some Strut Problems, John Case. Engineering, vol. 106, no. 2764, Dec. 20, 1918, pp. 699-670, 7 figs. Mathematical article discussing crippling load of a pin-jointed strut of verying section; deflection of a strut with lateral load; deflection of a strut subjected to lateral load and terminal couples; continuous beams with end load; proofs of formulæ.

Wing-Structure Calculation

Incidence Wires in the Strength Calculations of Wing Structures, John Case. Aeronautics, vol. 15, nos. 268, 270 and 271, Dec. 4, 18 and 25, 1918, pp. 516-517, 566-570 and 602-607, 25 figs. Dec. 4: Ordinary processes of statics and principle of least work, as methods of computing thrust in members of frame. Physical aspect of difference between the two methods; Dec. 18: Formulæ for estimating loads in spars, struts, etc., and numerical examples of the methods of using these formulæ; Dec. 25: derivation of formulæ.

MILITARY AIRCRAFT

British Planes

British Airplanes and Seaplanes. Automotive Industries, vol. 40, no. 3, Jan. 16, 1919, pp. 142-143. Principal types of engines and planes in use in the Royal Naval Air Service and in the Army.

U. S. Le Pere

The Le Père Fighter. Aerial Age, vol. 8, no. 18, Jan. 13, 1919, pp. 904-905, 5 figs. General dimensions, weights and performances of reconnaissance plane fitted with 400-hp. Liberty engine.

U. S. Planes

Record of Performance of American Planes. Automotive Industries, vol 40, no. 3, Jan. 16, 1919, p. 103. Table illustrating types and principal features of airplanes built by U. S. Government since June 1917.

MODELS

Model Construction

Model Aeroplane Building as a Step to Aeronautical Engineering. Aerial Age, vol. 8, nos. 18, 19 and 20, Jan. 13, 20 and 27, 1919, pp. 913, 957 and 1001, 11 figs. Jan. 13: Details of wings; Jan. 20: Making tail surfaces, fin and rudder; Jan. 27: Details of stabilizer, elevators, fin and rudder for Ford motored airplane.

Model Aeroplanes—XIX, F. J. Camm. Aeronautics, vol. 15, no. 268, Dec. 4, 1918, p. 529, 6 figs. Notes on driving mechanism.

PROPELLERS

Charts

Nomographic Charts for the Aerial Propeller, S. E. Slocum. Aerial Age, vol. 8, no. 20, Jan. 27, 1919, pp. 988-990, 4 figs. Power, thrust, torque and efficiency charts representing formulæ derived from experimental data. Formulæ were discussed in Aerial Age, Aug. 26 and Nov. 18, 1918.

Marine Engineering

AUXILIARY EQUIPMENT

Condensers

Auxiliary Machinery on British Standard Ships. Shipbuilding and Shipping Rec., vol. 12, no. 25, Dec. 19, 1918, pp. 595-596, 5 figs. General arrangement of auxiliary machinery for A and B types; details of auxiliary condenser incorporated in main engine structure on marine engines.

Propellers

Chart for Diameters of 3-Bladed Propellers. Motor Boat, vol. 16, no. 1, Jan. 10, 1919, p. 12, 1 fig. To determine diameter of propeller from desired revolutions and hp. delivered.

Screw Propellers, C. W. Dyson. Jl. Am. Soc. Naval Engrs., vol. 30, no. 4, Nov. 1918, pp. 753-805, 4 figs. Theoretical discussion covering thrust deduction and wake gain; slip block coefficients; wing screws; correction of slip block coefficient for variation of midship section coefficient from standard; mean relative tip clearance of propellers; resistance of hull appendages; basic conditions for analysis and design of screw propellers; general formulæ for power correction for "cavitation" and "dispersal of thrust column"; standard forms of projected area ratio; standard forms of blade sections; problems in propeller design.

Valves and Fittings

Marine Practice in Valves and Fittings, A. G. Christie. Mech. Eng., vol. 41, no. 2, Feb. 1919, pp. 135-136. Suggests that certain features of central-station practice be extended to marine practice.

SALVAGE

Salvaging Device

Making the Sea Give Up Its Wealth. Am. Marine Engr., vol. 14, no. 1, Jan. 1919, pp. 12-14, 1 fig. Patented salvaging device consisting of dual system of non-capsizing pontoons to serve as lighters for salvage and quarters and workshops for wrecking crews as well as for raising vessels on an even keel.

S.S. St. Paul

The Salvage of the St. Paul. Engineer, vol. 126, no. 3284, Dec. 6, 1918, pp. 480-483, 7 figs. Account of raising of liner which sank at her pier in New York harbor.

SHIPS

Camouflage

Principles Underlying Ship Camouflage, Alon Bement. Int. Mar. Eng., vol. 24, no. 2, Feb. 1919, pp. 90-93, 9 figs. Complementary colors to produce low visibility; dazzle system of ambiguous perspective to disguise ship's course; special color effects.

Castings

Castings Used in Ship Construction, Ben Shaw and James Edgar. Foundry Trade Jl., vol. 20, no. 203, Nov. 1918, pp. 579-584, 26 figs. Methods adopted in making pattern for and casting rudder; general considerations on large and small castings.

Concrete Vessels

Reinforced-Concrete Steamer "Armistice." Engineering, vol. 107, no. 2767, Jan. 10, 1919, pp. 46-48, 8 figs. Illustrations with general description of a 205-ft. concrete steamer constructed by the Ferro-Concrete Ship Construction Company, Limited, Barrow-In-Furness.

Concrete Ships. Times Eng. Supp., no. 530, Dec. 1918, pp. 252-253. Program at Lancashire yards; equipment of yards.

New Type of Reinforced Concrete Boat. Concrete Age, vol. 29, no. 3, Dec. 1918, pp. 24-25. System followed at Aberthaw yard for building 500-ton lighters.

Structural Details of Concrete Ships, W. Noble Twelvetrees. Nautical Gaz., vol. 95, no. 2, Jan. 11, 1919, pp. 24-25. Systems of concrete shipbuilding followed in British shipyards and advantages claimed by advocates of each system. From the Shipbuilder.

The Waller System of Reinforced Concrete Ship Construction, W. Noble Twelvetrees. Engineering, vol. -06, no. 2760, Nov. 22, 1918, pp. 580-583, 16 figs. Description of system introducing precast concrete slabs into construction.

Detail Drawing Methods

Detail Drawing Method Used for 8800-Ton Steel Ships. Eng. News-Rec., vol. 82, no. 4, Jan. 23, 1919, pp. 188-190, 3 figs. Adapted successfully to old-style ships of fully curved shape; permits checking pieces before they leave shop.

Electrical Installation Work

Cutting Time on Installation Work. Jl. Elec., vol. 42, no. 1, Jan. 1, 1919, pp. 25-26. Systematic planning of electrical installation work as carried out in large shipyard.

Electric Propulsion

The Ljungström Turbo-Electric System of Ship Propulsion. Jl. Am. Soc. Naval Engrs., vol. 30, no. 4, Nov. 1918, pp. 813-834, 60 figs. Ljungström turbine consists of two disks carrying intermeshing rings of reaction blading; each disk is direct-coupled to a generator. Turbine, equipment, auxiliaries and mountings are treated at length. From Engineering.

Electric Propulsion on the New Mexico, Wingrove Bathon. Elec. World, vol. 73, no. 1, Jan. 4, 1919, pp. 7-10, 1 fig. Interview with Rear-Admiral Griffin of U. S. N. New system of driving ships adopted as national policy; Great Britain and France probably will follow American lead.

Fabricated Ship

The Fabricated Ship in America. Engineer, vol. 126, no. 3286, Dec. 20, 1918, pp. 523-524, 12 figs. Description and discussion of the "fabricated" ship.

Ferry Steamers

Train Ferries to France. Times Eng. Supp., no. 530, Dec. 1918, p. 251, 3 figs. Engineering features of ferry steamers and of bridges for loading and unloading them.

Ford Chasers

Ford Methods in Ship Manufacture—II, Fred E. Rogers. Indus. Management, vol. 57, no. 2, Feb. 1919, pp. 119-124, 12 figs. Layout, equipment and tools of shop where 200 tons of interchangeable steel parts for the Eagles are produced in a working day. (To be continued.)

The Building of American Submarine Chasers, Engineering, vol. 106, no. 2761, Nov. 29, 1918, pp. 608-609, 3 figs. Account of construction of Ford "Eagles."

Groton Shipyard

Groton Shipyard Built on Sloping Limestone Ledge. Eng. News-Rec., vol. 82, no. 3, Jan. 16, 1919, pp. 135-138, 6 figs. Fabricating and storage yards level with rails on concrete craneways and 22 ft. above concrete shipways set into rock.

Hog Island Ship

Plans for Hog Island Steel Cargo Ship. Int. Mar. Eng., vol. 24, no. 2, Feb. 1919, pp. 71-74, 3 figs. Design and construction of single-screw vessel of 7500 tons deadweight type; cargo space 380,000 cu. ft.

Launching

Notes on Launching, William Gatewood. Engineering, vol. 106, no. 2764, Dec. 20, 1918, pp. 710-711, 7 figs.; Int. Mar. Eng., vol. 24, no. 2, Feb. 1919, pp. 83-87, 7 figs. Paper before Society of Naval Architects and Marine Engineers, Philadelphia, Nov. 1918.

Refrigerator Ships

The Refrigerator Ship "Belle-Isle" (Le navire frigorifique "Belle-Isle"), Emile Gouault. Génie Civil, vol. 73, no. 26, Dec. 28, 1918, pp. 501-504, 7 figs. Conformation and plans. Ship is three-decked and of awning-deck type, with capacity of 12,000 beeves.

Turbine Propulsion

Italian Geared Turbine Cargo Steamer. Int. Mar. Eng., vol. 24, no. 2, Feb. 1919, pp. 94, 2 figs. Brief description with plan of ship. Built by N. Odero & Company, at Sestri Ponenti, and fitted with Tosi geared turbine propelling and auxiliary machinery.

Progress in Turbine Ship Propulsion, Francis Hodgkinson. Engineering, vol. 107, no. 2767, Jan. 10, 1919, pp. 42-45, 9 figs. Report, slightly abbreviated, read before the Society of Naval Architects and Marine Engineers, Philadelphia, Nov. 1918.

Progress in Turbine Ship Propulsion, Francis Hodgkinson. Shipping, vol. 5, no. 13, Dec. 28, 1918, pp. 15-16, 1 fig. Auxiliaries used and practice followed. Abstract of paper before Soc. Naval Architects and Marine Engrs.

Ventilating and Heating

Ventilating and Heating from the Marine Point of View, Chas. F. Gross. Jl. Am. Soc. Naval Engrs., vol. 30, no. 4, Nov. 1918, pp. 728-736. Systems followed in merchant ships; design and installation of ventilators; allowance of square feet of radiator surface by leading shipbuilding companies.

Manufacturing a Ship's Ventilator, H. E. McCauley. Am. Mach., vol. 50, no. 2, Jan. 9, 1919, pp. 47-51, 15 figs. Describes manufacture of American-type ventilator cowls.

Welded Ships

The First Electrically Welded Boat, John Liston. Gen. Elec. Rev., vol. 21, no. 12, Dec. 1918, pp. 844-848, 10 figs. Particulars of boat built in 1915 at Ashtabula, Ohio, and still in service on Great Lakes.

The Adequacy of Welding in Constructing Hulls of Ships. H. M. Hobart. Gen. Elec. Rev., vol. 21, no. 12, Dec. 1918, pp. 840-843. Author expresses belief in adequacy of method.

Rules for Electrically-Welded Ships. Jl. Engrs. Club, St. Louis, vol. 3, no. 6, Nov.-Dec. 1918, pp. 331-334. Regulations adopted by general committee of Lloyd's Register of Shipping, London. From Nauticus, Sept. 7, 1918.

YARDS

Reduction Gears

Mechanical Reduction Gears, J. A. Davies. Jl. Am. Soc. Naval Engrs., vol. 30, no. 4, Nov. 1918, pp. 705-727, 11 figs. Formulæ for designing pinions; considerations on selection of material for bearings; types of couplings; undesirability of flexible couplings in high-powered, high-speed machinery; contour used for teeth of marine reduction gears of double-helical type; accidents and changes due to wear or operation.

Shipbuilding, United States and Canada

Shipbuilding Development in the United States and Canada, W. R. Gray and Edward F. Clarke. Engineering, vol. 106, no. 2765, Dec. 27, 1918, pp. 740-742, 3 figs. Paper before North-East Coast Inst. of Engineers and Shipbuilders, December 1918.

Shipyards

Recent Developments in Shipyard Plants, S. M. Henry. Int. Mar. Eng., vol. 24, no. 2, Feb. 1919, pp. 74-76. From a paper before the Society of Naval Architects and Marine Engrs.

Welding

Electric Welding in Navy Yards, H. G. Knox. Gen. Elec. Rev., vol. 21, no. 12, Dec. 1918, pp. 849-859, 20 figs. Arc-welding and resistance welding processes as related to their general application in navy yard; work conducted in each type of shop; recommendations as to kinds of welding equipment desirable; figures of speed and cost of welding ship structures.

Organization and Management

ACCOUNTING

Ice-Plant Auditing

Auditing and Supervision of Ice Plants, George E. Wells. Ice & Refrigeration, vol. 56, no. 1, Jan. 1919, pp. 48-49. Proposes auditing engineering conditions in a plant and gives particulars and audit forms for ice plants.

Appraisals, Industrial

Three Industrial Appraisals in One, Charles W. McKay. Indus. Management, vol. 57, no. 2, Feb. 1919, pp. 141-143. For excess-profits tax computation, for plant accounting and for insurance adjustment.

EDUCATION

Agricultural Instruction

Reference Material for Vocational Agricultural Instruction. Federal Board for Vocational Education, bul. 13 and 14, March and June 1918, 42 pp. and 25 pp. March: Outlines provisions to be made by states for meeting requirements of Smith-Hughes Act relating to agricultural instruction. June: Suggestions for cataloging and filing, bulletin, report, etc., for agricultural education.

Airplane Mechanics

Emergency War Training for Airplane Mechanics. Federal Board for Vocational Education, bul. no. 12, April 1918, 62 pp. Outline of course in airplane construction and repair.

Crippled Soldiers

The Evolution of National Systems of Vocational Reëducation for Disabled Soldiers and Sailors. Douglas C. McMurtrie. Federal Board of Vocational Education, bul. 15, May 1918, 318 pp., 33 figs. Fundamental principles of rehabilitation; categorical description of methods for vocational rehabilitation in force in the various warring countries, including Germany and Austria-Hungary; extensive bibliography of American and foreign literature, inclusive of news items in periodicals, relating to vocational rehabilitation.

Cripples

Reducing the Cost of Disability, Douglas C. McMurtrie. Iron Age, vol. 103, no. 6, Feb. 6, 1919, pp. 362-363. Rehabilitation restores and may enhance earning capacity; insurance costs lessened; the economy of liberal medical attention.

The Conservation of Industrial Man Power, Arthur J. Westermayr. Am. Drop Forger, vol. 4, no. 12, Dec. 1918, pp. 504-506, 3 figs. Question of rehabilitating crippled soldiers; how vocational rehabilitation act will be operated.

Engineering Colleges

The Effect of the War on Engineering Education, C. R. Mann. Bul. Soc. Promotion Eng. Education, vol. 9, no. 4, Dec. 1918, pp. 108-118. War experiences analyzed under (1) production of soldiers, and (2) production of supplies. Present college curricula described as aiming to impart knowledge of physical laws and properties of materials exclusively, and as insufficient to develop men who will accomplish reorganization of industrial production, for which task an understanding of the methods by which human wills are coördinated for team play is essential.

Export and Shipping

Vocational Education for Foreign Trade and Shipping. Federal Board for Vocational Education, bul. 24, Nov. 1918, 85 pp. Present importance of education for foreign trade; advanced courses in shipping; coöperative plans for teaching foreign trade; study outlines of fundamental courses; suggested study plans.

Industrial Education

Industrial Education in Wilmington, Delaware. Department of Interior, Bur. of Education, bul. 25, 1918, 97 pp. Report of survey made under direction of Commissioner of Education; suggestions for program of industrial education.

Industrial Schools

Buildings and Equipment for Schools and Classes in Trade and Industrial Subjects. Federal Board for Vocational Education, bul. 20, Nov. 1918, 75 pp., 25 figs. Type schools and classes; detailed description of building and equipment for a trade or industrial school; equipment, courses of study, and methods of instruction in carpentry.

Evening Industrial Schools. Federal Board for Vocational Education, bul. 18, Sept. 1918, 55 pp. Possibilities in evening schools under provisions of Smith-Hughes Act; suggestive courses which have been prepared and carried out at evening schools; approved methods of establishing and conducting evening industrial schools for trade workers.

Italy

Need for Increased Technical Education in Italy (Per l'avvenire della industria meccanica in Italia), G. Belluzzo. Industria, vol. 32, no. 21, Nov. 15, 1918, pp. 635-637. Points out defects of Italian system of training as at present conducted and outlines a system which follows closely that given in best shops in England and United States. (Concluded.)

Naval Architecture

The Requirements of a Course of Training in Naval Architecture, Lawrence B. Chapman. Bul. Soc. Promotion Eng. Education, vol. 9, no. 4, Dec. 1918, pp. 119-130. Outlines plan in which professional work starts early in course and parallels outside training.

Part-Time Schools

Part-Time Trade and Industrial Education. Federal Board for Vocational Education, bul. 19, Oct. 1918, 51 pp. Need for part-time schools in United States; school, man and employer as factors in promoting part-time education; part-time studies already established in U. S.; continuation schools in England, France and Germany; types of part-time schools; federal aid; principles which should underlie compulsory legislation.

Physical Education

Recent State Legislation for Physical Education, Thomas A. Storey and Willard S. Small. Department of Interior, Bureau of Education bul. 40, 1918, 35 pp. Chronological analysis of laws enacted in eight states since the beginning of the war; analysis of purpose and scope of state laws; principles of state legislation for physical education; state laws for physical education.

Radio Operators

Emergency War Training for Radio Mechanics and Radio Operators. Federal Board for Vocational Education, bul. no. 16, Sept. 1918, 74 pp., 8 figs. Outline of course for preliminary training.

Secondary Education

Cardinal Principles of Secondary Education. Department of Interior, Bur. of Education, bul. 35, 1918, 32 pp. Report of Commission on the Reorganization of Secondary Education, appointed by Nat. Education Assn.

Shop Training

Training Operators at Winchester Plant, W. E. Freeland. Iron Age, vol. 103, no. 3, Jan. 16, 1919, pp. 178-179, 2 figs. Short intensive course in training shop for men; three years' apprenticeship in school for boys; details of system. (Eleventh article of series on Winchester plant.)

The Training Department — Past and Future, John C. Spence. Iron Age, vol. 103, no. 4, Jan. 23, 1919, pp. 237-239. The crippling of one plant for another; real and pretended interest in workmen; some training plans for the common good.

Technical Education, Primary

Toronto Builders' Exchange Urges Forward Movement in Technical Education. Contract Rec., vol. 33, no. 3, Jan. 15, 1919, p. 49. Deputation recommends Ministry of Education that technical schools be owned by Government, that education be made compulsory between 14 and 20 years and that parents decide boy's vocation.

Trade and Industrial Education, Organization and Administration. Federal Board for Vocational Education, bul. no. 17, Oct. 1918, 124 pp. Contains information and suggestion concerning organization and administration of trade and industrial schools and class under Federal law.

U. S. Training Service

The U. S. Training Service and Its Work, Charles T. Clayton. Indus. Management, vol. 57, no. 2, Feb. 1919, pp. 103-104. Value of service in saving to manufacturers expense of hiring men; industrial training as a means of lessening turnover and increasing output.

Universities

The Universities and the New World, Geo. F. Swain. Jl. Elec., vol. 42, no. 1, Jan. 1, 1919, pp. 12-14. Readjustment of schools and universities to fulfil new demands in education created by general reconstruction of past conditions.

Welders

The Training of Electric Welders, H. A. Horner. Gen. Elec. Rev., vol. 21, no. 12, Dec. 1918, pp. 876-881, 9 figs.

Emergency War Training for Oxy-Acetylene Welders. Federal Board for Vocational Education, bul. no. 11, June 1918, 86 pp., 20 figs. History of development and application of oxy-acetylene in industry and war; U. S. Army course of instruction in oxy-acetylene welding and oxygen cutting.

Operators and Instructors Necessary for Electric Arc Welding. Elec. Ry. Jl., vol. 53, no. 4, Jan. 25, 1919, pp. 191-192, 4 figs. From 1918 report of Committee of Association of Railway Electrical Engineers.

The Future of Army Welding Schools, Cyrus K. Rickel. Jl. Acetylene Welding, vol. 2, no. 7, Jan. 1919, pp. 331-335, 7 figs. Discusses qualifications of successful welding school.

Women Workers

Little Causes and Great Effects (Petites causes et grands effects), Francois Villain. Société Industrielle de d'Est. bul. 142, Nov. 1918, pp. 7028, 8 figs. Plea for enforcing law which requires teaching of household arts to young girls in elementary schools; influence of this policy on welfare of women. Conference before the Société Scientifique d'Hygiene Alimentaire.

Training Women for Record Output, Robert I. Clegg. Iron Age, vol. 103, no. 3, Jan. 16, 1919, pp. 169-174, 11 figs. General results abroad and at home; diligence and industry of women; practical system of schooling on shop production lines.

FACTORY MANAGEMENT

Employment Management

The "Conscience" of Modern Industry, C. T. Clayton. Jl. Engrs. Club St. Louis, vol. 3, no. 6, Nov.-Dec. 1918, pp. 352-354. Employment management as a factor to reduce industrial misunderstanding and friction.

Extreme Methods in Employing, Charles M. Horton. Indus. Management, vol. 57, no. 2, Feb. 1919, pp. 145-148. Criticises some practices of employment managers.

Industrial Fatigue

A Suggestion for the Prevention of Waste of Human Energy in Factories, H. G. P. Castellain. Cassiers Eng. Monthly, vol. 54, no. 6, Dec. 1918, pp. 303-307. Discusses industrial fatigue from a medical point of view and suggests improvement in medical education and establishment of courses for factory inspectors and medical men.

Investigations

Engineer and Plant Management, J. G. Worker. Aera, vol. 7, no. 6, Jan. 1919, pp. 596-599. Suggestions as to investigations, reports and installations of waste preventing boiler room methods.

Labor Management

Use of Non-Financial Incentives, Robert B. Wolf. Can. Mfr., vol. 39, no. 1, Jan. 1919, pp. 79-80, 2 figs. Stimulating production in industry by internal motives rather than by external discipline, that is, by making comparisons, cost sheets, etc.

Observation

The Value of Observation in Works Practice, H. H. Ashdown. Engineering, vol. 107, no. 2766, Jan. 3, 1919, pp. 11-14, 14 figs. A paper before the Society of Engineers and Metallurgists, Sheffield, Nov. 1918.

Plant Operation

Lifting Power Plant Capacity by Its Boot Straps, Charles L. Hubbard. Factory, vol. 22, no. 1, Jan. 1919, pp. 35-37, 1 fig. Improvements which contribute to increasing efficiency; how superheating steam increases capacity; how increasing speed affects engine; use of compound engines or low-pressure turbines.

Production Control

Graphic Production Control—VI, C. E. Knoeppel. Indus. Management, vol. 57, no. 2, Feb. 1919, pp. 113-118, 10 figs. Two ways to tie together and coördinate various features of control mechanism: by use of charts, and by control boards. Last article of series.

Overtime

Graphic Analysis of an Overtime Problem, R. von Huhn. Indus. Management, vol. 57, no. 2, Feb. 1919, pp. 86-88, 5 figs. Casting delivery on a large contract and amount of overtime needed to machine pieces.

Reports

Facilitating Sewer Pipe Factory Management, W. B. Harris. Brick & Clay Rec., vol. 54, no. 1, Jan. 14, 1919, pp. 39-44, 10 figs. Forms and records of making reports; placing workmen.

Stokers

Power Plant Management: Mechanical Stokers, Robert June. Power House, vol. 11, no. 12, Dec. 1918, pp. 353-355, 2 figs. Efficiency; characteristics of chain grate; instructions for operation.

Storage of Materials

Principles of Purchasing and Storing Applied to Rough, Bulky Materials in Yard Storage, Dwight T. Farnham. Indus. Management, vol. 57, no. 2, Feb. 1919, pp. 108-112, 7 figs. Six principles are considered in planning yard storage: Effort required to transport; weight and material to be stored on each square foot of space; rate of stores turnover; storage unit; allotted space; efficient package.

Timekeeping

Providing a Double Check on Timekeeping. Factory, vol. 22, no. 1, Jan. 1919, pp. 48-50, 4 figs. Layout of Eastman Kodak Co. time-clock room.

Water Works

Office Records of the St. Louis Water Division, Distribution Section, Thomas E. Flaherty. Jl. Am. Water Works Assn., vol. 5, no. 4, Dec. 1918, pp. 412-418. Brief description of organization for planning, direction and execution of work.

Welfare Work

Promoting Employees' Welfare Brings Large Returns. Ry. Maintenance Engr., vol. 15, no. 1, Jan. 1919, pp. 5-8, 8 figs. Policies of Richmond, Fredericksburg & Potomac R. R. Co.

FINANCE AND COST

Cost Accounting

Cost Accounting to Aid Production—V, G. Carter Harrison. Indus. Management, vol. 57, no. 2, Feb. 1919, pp. 131-139, 4 figs. Diagrams illustrating coördinated cost, planning and production systems. (To be continued.)

Costing at National Factories, W. Webster Jenkinson. Iron & Coal Trades Rev., vol. 97, no. 2643, Oct. 25, 1918, pp. 455-458, 10 figs. Beginning series of articles abstracts from address before London School of Economics and Political Science.

Power Costs

Simple Method of Determining Power Costs, T. H. Fenner. Power House, vol. 11, no. 12, Dec. 1918, pp. 361-363, 1 fig. How to arrive at costs when no instruments are available.

Works Costs

The Economics of Works Costs, J. R. Dick. Elecn., vol. 81, no. 2115, Nov. 29, 1918, pp. 643-645, 2 figs. (First installment of a continued article.)

FOREIGN TRADE

Boilers

New Foreign Markets for American Made Boilers and Boiler Equipment, L. W. Alwyn-Schmidt. Boiler Maker, vol. 19, no. 1, Jan. 1919, pp. 3-4. Exports increased over one-sixth. New fields developed in South America and the Far East. European markets remain on war footing.

Canadian Exports

Canadian Industries and the Export Trade, J. F. Heffron. Can. Machy., vol. 21, no. 1, Jan. 2, 1919, pp. 9-12. Canadian possibilities in developing foreign trade; German credit methods of fostering export trade; articles for export.

Drop-Forge Equipment

Campaigning for Foreign Business, L. W. Alwyn-Schmidt. Am. Drop Forger, vol. 5, no. 1, Jan. 1919, pp. 3-6. Suggestions to obtain foreign drop-forge business.

German Methods

Effectiveness and Service in Foreign Trade. Textile World Jl., vol. 55, no. 2, Jan. 11, 1919, pp. 127 and 159. Necessity of considering customer's viewpoint; German commercial vices.

German Foreign Trade Extension Measures, Norman L. Anderson. Blast Furnace, vol. 7, no. 1, Jan. 1919, pp. 78-79. Private associations for promoting foreign trade; German exhibitions; government trade activities; purposes of suggested "Auslandamt."

Italian Market

Our Opportunities for Foreign Trade, V. Macchi di Celler̀e. Am. Drop. Forger, vol. 5, no. 1, Jan. 1919, p. 17. Market possibilities of Italy, from address before Am. Mfrs. Export Assn.

INSPECTION

Ordnance Department Methods

How Ordnance is Inspected, Fred H. Colvin. Am. Mach., vol. 50, no. 6, Feb. 6, 1919, pp. 263-267, 8 figs. Description of organization and methods of Ordnance Department for inspection.

LABOR

Bathhouses

Mine Bathhouses in Utah, A. C. Watts. Coal Age, vol. 15, no. 1, Jan. 2, 1919, pp. 4-8, 4 figs. Description of typical bathhouses with comparison of American and European costs.

Blind

An Experiment in Employing the Blind, Dale Wolf. Indus. Management, vol. 57, no. 2, Feb. 1919, pp. 105-107. How blind men have been put to work on jig drilling of shackles for locks.

Bonus System

Bonus System in Power Generation, W. L. Whitlock. Nat. Engr., vol. 23, no. 1, Jan. 1919, pp. 9-11, 2 figs. Standing order to employees and scale for computing bonus. System of Denver Tramway Co., which is said to effect saving of $150,000 per year.

Bonus System Reduces Coal Consumption at Denver, W. E. Casey and E. Weber. Elec. Ry. Jl., vol. 53, no. 6, Feb. 8, 1919, pp. 266-271, 7 figs. By installation of new turbine and introduction of bonus system, coal consumption on Denver Tramway System is reduced to less than 2.5 per kw-hr., with saving in operating expense of $150,000 per year.

Coal-Economy bonuses in a Central Electric Power House (Prime au personnel sur les économies de charbon dans une centrale électrique thermique), M. Grospaud. Revue Générale de l'Electricité, vol. 5, no. 2, Jan. 11, 1919, pp. 58-63. From data showing variations in thermal efficiency of coal, writer concludes it is illusory to base bonus system on coal consumption; he proposes instead a system based on scientific and methodic thermal control and outlines its practical working details.

The Engineer—Worker and Organizer, G. W. Tripp. The Central (Jl. City & Guilds Eng. Col.), vol. 15, no. 44, Dec. 1918, pp. 46-54, 1 fig. Comparison between Rowan bonus scheme and system based on 50 per cent payment. Abstract of lecture to Woolwich Arsenal apprentices.

British

Paper on "The Industrial Future," Cecil Walton. Jl. West of Scotland Iron & Steel Inst., vol. 26, pt. 2, session 1918-1919, 19-24 and (discussion) pp. 25-31. Labor conditions and the future development of Glasgow. Reference is made to question of wages.

Labor Administration, Edward T. Elbourne. Engineer, vol. 126, nos. 3282, 3283, 3284, 3285, and 3287, Nov. 22 and 29, Dec. 6, 13 and 27, 1918, pp. 432-435, 7 figs.; pp. 453-454, 3 figs.; pp. 478-480, 5 figs.; pp. 504-507, 5 figs.; pp. 548-550, 4 figs. Nov. 22: Control of production. Nov. 29, The wages office. Dec. 6; Wages office continued. Dec. 13: Accidents. Dec. 27: General discipline and general facilities. (Articles 9-13 inclusive.)

Canada

Education and Coöperation the Wisest Course in Dealing with Labor, Gideon Robertson and T. Moore. Contract Rec., vol. 33, no. 2, Jan. 8, 1919, pp. 19-20. Opinions and suggestions of Canada Minister of Labor and of the President Trades and Labor Congress.

Crippled Workers

Human Reconstruction Reclaims War's Disabled for Industry, W. H. Lloyd. Iron Trade Rev., vol. 64, no. 1, Jan. 2, 1919, pp. 80-86, 11 figs. Courses being offered to disabled soldiers and employments being secured for them.

How to Deal with Our Crippled Workers, T. Norman Dean. Am. Drop Forger, vol. 4, no. 12, Dec. 1918, pp. 498-500. Indicates that rehabilitation should be carried on scientifically.

The Conservation of Industrial Man Power, Arthur J. Westermayr. Am. Drop Forger, vol. 4, no. 12, Dec. 1918, pp. 504-506, 3 figs. Question of rehabilitating crippled soldiers so that they can stand on their own merits; discussion of rehabilitation vocational act.

Employment Department

The Principles of Employing Labor, E. H. Fish. Indus. Management, vol. 57, no. 2, Feb. 1919, pp. 81-85. Fundamental principles underlying establishment and maintenance of employment department, promotion of personal relations. First of five articles.

Federal Control

What Federal Control Has Done for Labor, W. S. Carter. Ry. Maintenance Engr., vol. 15, no. 1, Jan. 1919, pp. 11-12. Résumé of measures taken to improve relations between managements and employees. Abstract from address delivered before convention of Acad. Political Sci.

Housing

Housing the Workers—An Unfinished Job, George Gove. Am. City, vol, 20, no. 1, Jan. 1919, pp. 23-25. Present status of Government housing projects. Challenge to local chambers of commerce to meet emergency.

The Present and Future Government of War-Created Communities, Ernest Cawcroft. Jl. Am. Inst. Architects, vol. 6, no. 12, Dec. 1918, pp. 553-558. Suggestions in regard to housing projects undertaken by War Department, Navy Department, U. S. Housing Corporation and U. S. Shipping Board.

Labor Problem

The Labor Problem Analyzed, Magnus W. Alexander. Open Shop Rev., vol. 16, no. 1, Jan. 1919, pp. 3-16. Social, political and economic aspects of labor problem. Address delivered at convention of Nat. Founders' Assn. (To be continued.)

Lunch Rooms

Mill Lunch Room for Employees, A. W. Anderson. Textile World Jl., vol. 55, no. 2, Jan. 11, 1919, pp. 397 and 401, 4 figs. Description of employees' rooms used by several companies.

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Older Men

Superannuation of Technical Men. Times. Eng. Supp., no. 530, Dec. 1918, p. 257. Proposes that industrial firms take over policies of technical men in their employment and keep them on same basis as adopted in federation of universities.

Profit Sharing

Enlisting Labor in Production, L. W. Schmidt. Am. Mach., vol. 50, no. 6, Feb. 6, 1919, pp. 253-256, 3 figs. Some methods of making labor interested in the part it is playing in production.

Wage Questions Must Be Handled from Inside the Industrial Unit, Harry Tipper. Automotive Industries, vol. 40, no. 2, Jan. 9, 1919, pp. 62-63. Importance of profit-sharing collective agreement.

Representation of Employees

Where the Men Settle Their Own Troubles. Factory, vol. 22, no. 1, Jan. 1919, pp. 29-31, 1 fig. A board of appeals, consisting of two representatives from each department, one elected by the workers, the other appointed by management, has jurisdiction over all controversies concerning wages, hours of work, discharges, promotions, etc.

Turnover of Labor

Labor Maintenance and Its Indices, Winthrop Talbot. Indus. Management, vol. 57, no. 2, Feb. 1919, pp. 127-130, 2 figs. Criticism of accepted theories of labor turnover and methods for computing it as percentage; presentation of theory of labor maintenance and a way of calculating indices to show stability, maintenance and replacement of working force.

Wages

Notes on the Formulæ of Modern Wages (Quelques réflexions sur les formules de salaire moderne). Génie Civil, vol. 73, no. 22, Nov. 30, 1918, pp. 425-428, 5 figs. Graphical representation and study of characteristic functions of form $s/S_0 = f(m)$ where s is actual wages, S_0 wages per day or hour and *m* activity, i.e., ratio of work actually produced to work corresponding to wages paid.

Labor's Share. Min. & Sci. Press, vol. 117, no. 26, Dec. 28, 1918, pp. 864-866. Conditions brought about by abnormal requirements of war; objections raised by workmen to changing war scale.

The Human Factor in Shop Production, Margaret K. Strong. Am. Drop Forger, vol. 4, no. 12, Dec. 1918, pp. 489-490. Points out that high wages gives high productiveness because workman who is well fed and nourished can do greater amount of work.

Wages in War and in Peace. Open Shop Rev., vol. 16, no. 1, Jan. 1919, pp. 19-23. Impossibility of maintaining present high wages.

The Modern Wage Rates and the Public Works and Construction (Les tarifs de salaire moderne et l'entreprise de travaux publics et du bâtiment). G. Bouf. Génie Civil, vol. 74, no. 1, Jan. 4, 1919, pp. 9-11, 1 fig. Study of Taylor's system of rational wages; instituting bonuses.

Women

The Employment of Women in Acetylene Welding, Helen G. Fisk. Jl. Acetylene Welding, vol. 2, no. 7, Jan. 1919, pp. 348-354. Abstract of preliminary report of Chicago district ordnance office on activities of women in acetylene-welding field during the war.

The Employment of Women in the Machine Tool Industry, Alfred Herbert. Eng. Rev., vol. 32, no. 6, Dec. 16, 1918, pp. 161-163. Scope for their employment after war; plea for fixing minimum wage or maximum working hours. Text of memorandum submitted by Machine Tool & Eng. Assn. to War Cabinet Committee on Women in Industry.

Mental Function in the Work of Women (La fonction mentale dans le travail féminin), Jules Amar. Comptes rendus des seances de l'Académie des Seances, vol. 167, no. 22, Nov. 25, 1918, pp. 788-791. Psycho-motor reactions in women; physiological examination of their endurance.

Women a Fixture in Electrical Industry. Iron Age, vol. 103, no. 6, Feb. 6, 1919, pp. 353-354, 3 figs. Special provision for employment, welfare and safety are made by the Westinghouse Co.; shop and technical courses are provided.

Women Workers—Have They Made Good? Mary N. Winslow and Edgar E. Adams. Am. Drop Forger, vol. 5, no. 1, Jan. 1919, pp. 12-16, 5 figs. Records of past year; part played by women in war-time industries; present problems; fact concerning employment of women in various plants.

LEGAL

Accident Compensation

When is an Industrial Accident? Business Digest & Investment Weekly, vol. 23, no. 3, Jan. 21, 1919, pp. 92-93. Phraseology of compensation insurance laws in various states and legal decisions by different courts in United States and Great Britain.

"Pre-Existing" Condition of the Workman and Its Relation to Compensation for Injury, Chesla C. Sherlock. Am. Mach., vol. 50, no. 2, Jan. 9, 1919, pp. 67-69. Explanation with citations of zone court decisions.

Patent Laws

United States Patent Law and Procedure, E. E. Huffman. Jl. Engrs. Club St. Louis, vol. 3, no. 6, Nov.-Dec. 1918, pp. 335-351. Outline of patent system; suggested changes. Address delivered at joint meeting of Assoc. Eng. Soc., St. Louis.

The Rights to Patents and Inventions, Chesla C. Sherlock. Am. Mach., vol. 50, no. 3, Jan. 16, 1919, pp. 115-118. Quotes some notable decisions in respect to patent rights.

The New Patent Law Drafted for Hungary and Its Influence Upon Engineers (Der neue ungarische Patengesetzentwurf mit besonderer Ruecksicht auf die Stellung der Techniker), Dr. Rudolf v. Schuster, President of Patent Court. Zeitschrift des Oesterr, Ingenieur- und Architekten-Vereines, Vienna, vol. 70, no. 37, Sept. 13, 1918, pp. 399-402. Defends the provisions of the proposed patent law for Hungary. Advocates coöperation of engineers and lawyers.

The Crucial Question of Patents, Robert Hadfield. Eng. Rev., vol. 32, no. 6, Dec 16, 1918, pp. 157-160. How Board of Trade can provide strong stimulus to British scientific and engineering progress by applying its present powers to effect modification of patent law.

Patent Law Amendment. Jl. Instn. Elec. Engrs., vol. 57, no. 277, Dec. 1918, pp. 64-71. Report of patent-law committee adopted by conference of representatives of 30 leading scientific and technical societies, convened by Instn. Mech. Engrs.

The Patent Situation in the United States. Mech. Eng., vol. 41, no. 2, Feb. 1919, pp. 147-149 and 199. Report of Patent Committee to the National Research Council.

See also MINING ENGINEERING, Mines and Mining (Laws); ELECTRICAL ENGINEERING, Generating Stations (Legal Liability)

LIGHTING

Industrial Lighting

Artificial and Natural Industrial Lighting, C. E. Clewell. Elec. World, vol. 73, no. 1, Jan. 4, 1919, pp. 22-25, 8 figs. Their interrelations considered; predetermination of artificial lighting requirements; variation in natural lighting intensities; importance of daylight factor; methods of measurement.

Engineering Aspects of Industrial Lighting, C. E. Clewell. Elec. World, vol. 73, nos. 2 and 6, Jan. 11 and Feb. 8, 1919, pp. 68-71 and 260-262, 7 figs. Jan. 11: Industries should take advantage of studies made under stress of war conditions to promote efficiency of production; specific data now available which aid in selection and location of lighting units. Feb. 8: Economic considerations of the accident rate; relation to coal conservation; well-lighted versus poorly-lighted aisles; desirability of more widespread and intelligent use of reflectors for all lamps.

Mill Lighting

Modern Lighting and Power Installation for Canadian Knitting Mill. Elec. Rev., vol. 74, no. 4, Jan. 25, 1919, pp. 127-130, 7 figs. Electrical equipment complete and designed to minimize fire and accident hazards; details of lighting and power facilities.

Progress in Mill Lighting Practice, H. H. Magdsick. Textile World, Jl., vol. 55, no. 2, Jan. 11, 1919, pp. 401 and 403, 5 figs. State and Federal regulations; developments in accessories.

Street Lighting

The Street Lighting of the City of Buffalo, W. F. Schwartz. Am. City, vol. 20, no. 1, Jan. 1919, pp. 48-50, 4 figs. System comprises type C nitrogen-filled lamps, luminous arcs, pendent magnetite arcs, and enclosed carbon arcs, as well as gas lamps of Welsbach boulevard and ornamental types, and gasoline lamps. Number and cost of each type are given.

Yard Lighting

Light as an Aid to the Movement of Materials, A. L. Powell and R. E. Harrington. Ry. Elec. Engr., vol. 10, no. 1, Jan. 1919, pp. 9-13, 7 figs. Expedition of freight handling at transfer platforms and piers. Abstract of paper before Illum. Engr. Soc.

PUBLIC REGULATION

Plant Management

Industrial Economy (Economia Industrial), V. Posada Gavira. Boletin de Minas, vol. 10, nos. 7-9, Sept. 30, 1918, pp. 129-149, 1 fig. Coördination and harmonization of the technical, economical and human elements in industry by central administration, standardization and specialization.

Public Works

A National Department of Public Works, C. E. Grunsky. Jl. Elec., vol. 42, no. 1, Jan. 1, 1919, pp. 16-17. Advisability of creating department of public works to be represented in President's cabinet. Gain in efficiency is claimed over present distribution of engineering work under five different departments.

Street Cars

The National Aspect of the Public Utility, Franklin T. Griffith. Jl. Elec., vol. 42, no. 2, Jan. 15, 1919, p. 78. Question of higher street-car fare discussed from standpoint of what may legitimately be done to keep them low.

RECONSTRUCTION

British Plans

England's Vast Plans for Peace Work, Carroll E. Williams. Mfrs. Rec., vol. 75, no. 3, Jan. 16, 1919, pp. 90-92. New shipyards built in record time; building of concrete ships; recommendation of British reconstruction committee on relations between employers and employees; reconstruction of iron and steel business.

Engineering Problems

The Economic Duties of the Engineer, W. R. Ingalls. Eng. & Min. Jl., vol. 107, no. 4, Jan. 25, 1919, pp. 184-190. Engineering problems in reconstruction.

Engineering Societies

What Engineering Societies Should Do to Assist in Providing Work for Soldiers and Others Who Will Soon Be Out of Work. Bul. Affiliated Eng. Societies Min., vol. 3, no. 12, Dec. 1918, pp. 221-222. From Eng. & Contracting.

France

America and Reconstruction in Europe. Jl. Elec., vol. 42, no. 1, Jan. 1, 1919, pp. 18-19. Plans of directors and representatives of large power stations and electric lighting plants situated in devastated regions of France; work done by British Ministry of Reconstruction; post-war preparations in Spain.

Helping France an Aid to America, John V. Schaefer. Iron Trade Rev., vol. 64, no. 3, Jan. 16, 1919, pp. 207-208. Sending of vast stores of army construction material and experts to help rehabilitate country urged as a means of solving our labor problem, securing war loan and laying foundation of future trade.

Reconstruction Plans

Industrial Relations After the War, Henry P. Kendall. Textile World Jl., vol. 55, no. 2, Jan. 11, 1919, pp. 121, 247 and 249. Need of constructive plan acceptable to all; basic principles that should control.

The Human Factor in Industry, A. P. M. Fleming. Jl. Instn. Elec. Engrs., vol. 57, no. 277, Dec. 1918, pp. 47-56. Means which make for improvement in material prosperity of those engaged in industry; pressing problems in industrial reconstruction.

Research

Science and the After-the-War Period, George K. Burgess. Jl. Wash. Acad. Sci., vol. 9, no. 3, Feb. 4, 1919, pp. 57-70. Importance, during transition period, of proper balance and distribution of scientific forces; advisability of retaining more than a nucleus of an organization of scientific men in service of Government and especially in military and naval establishments.

Scientific Leadership

Human Instincts in Reconstruction, William Henry Smyth. Indus. Management, vol. 57, no. 2, Feb. 1919, pp. 89-91. Suggests leadership of a national council of scientists as means for directing forces of human instincts.

Steel Trade and Shipbuilding

The Steel Trade and Shipbuilding Competition, E. T. Good. Cassier's Eng. Monthly, vol. 54, no. 6, Dec. 1918, pp. 342-345. Interdependence of steel trade and shipbuilding industries; warning against separation of their common interests and against German dumping methods.

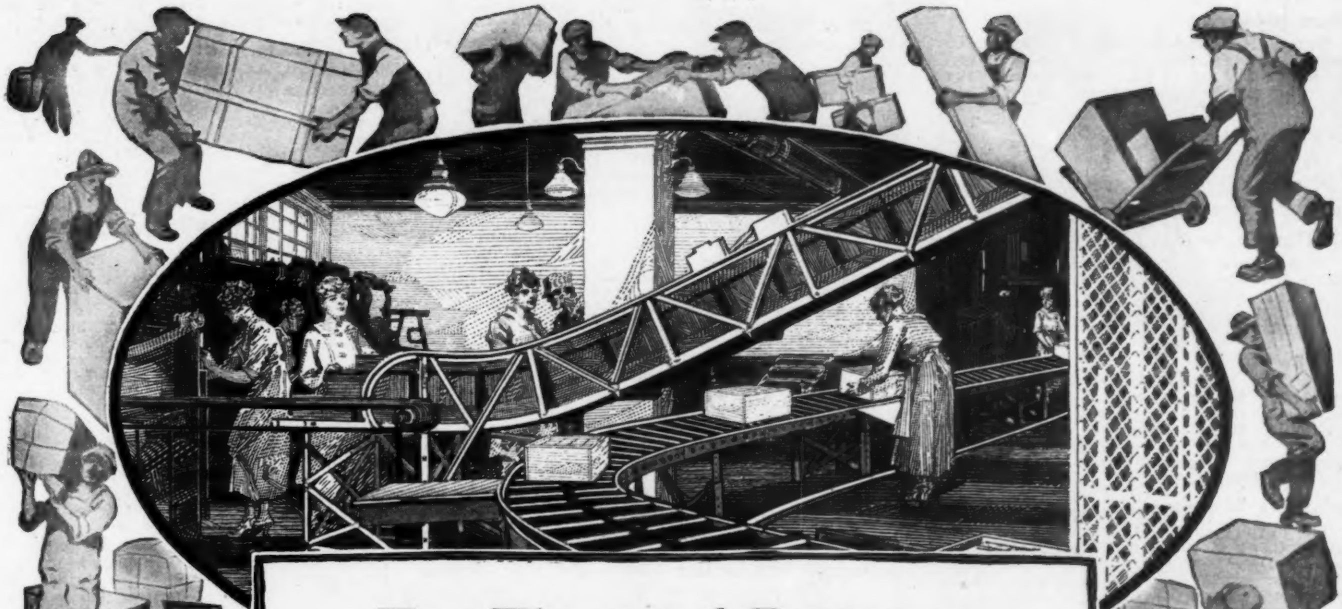
War Developments

War Developments in Industry, Kellaway. Engineering, vol. 106, no. 2763, Dec. 13, 1918, pp. 672-673. Address before Industrial Reconstruction Council, November 1918..

SAFETY ENGINEERING

Accidents and Output

Welfare and Safety. Cassier's Eng. Monthly, vol. 54, no. 6, Dec. 1918, pp. 316-324, 4



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Lamson Conveyors

figs. Effect of industrial accidents upon output; means whereby incidence of industrial casualties may be considerably diminished.

Cement Industry

Safety Hazards of Cement Industry, O. C. Soderquist. Concrete Mill Section, vol. 14, no. 1, Jan. 1919, pp. 11-12. Itemizes cement-mill dangers and suggests safety principles and rules.

Fire Protection

Automatic Sprinklers for Fire Protection, Arthur Bateman. Domestic Eng., vol. 86, no. 2, Jan. 11, 1919, pp. 81-83, 4 figs. Notes on their construction, installation and operation.

Grain-Dust Explosions

Experiments with Grain Dust Explosions, Earle William Gage. Am. Miller, vol. 47, no. 2, Feb. 1, 1919, pp. 137-138, 4 figs. Investigations to determine possible cause of explosion and to test various preventive measures.

Lighting

Relation Between Light Curtailment and Accidents, R. E. Simpson. Nat. Engr., vol. 23, no. 1, Jan. 19, 1919, pp. 6-8. Survey of accidents due to improver or inadequate illumination; effect of diminished lighting; suggestions. Paper presented at convention of Illum. Eng. Soc.

Overheating Workmen

The Problems of Overheating Workmen, Chesla C. Sherlock. Am. Drop Forger, vol. 4, no. 12, Dec. 1918, pp. 506-507. Methods of protecting workmen who are in contact with high temperatures; liabilities of employer.

Safety Fuse

Use and Abuse of Safety Fuse. Eng. & Min. Jl., vol. 107, no. 5, Feb. 1, 1919, pp. 229-231. Abstracted from bul. 9 of Indus. Accident Commission, Cal.

See also RAILROAD ENGINEERING, Safety and Signaling Systems.

SALVAGE AND WASTE PREVENTION

High-Speed Steel

The Salvage of High-Speed Steel Tools. J. H. Vincent. Am. Mach., vol. 50, no. 4, Jan. 23, 1919, pp. 169-170, 4 figs. Salvaging milling cutters at comparatively small cost by method of grinding without drawing temper of cutter.

Rust Prevention

Rust Prevention as a Steel Conservation Measure, Denis O'Brien. Elec. Ry. Jl., vol. 53, no. 5, Feb. 1, 1919, pp. 243-244. Writer's experiences in removing rust from steel cars and preventing its spreading to a damaging extent.

Scrap

Saving the Waste with an Electric Furnace, C. B. Merrick. Jl. Elec., vol. 42, no. 1, Jan. 1, 1919, pp. 30-31, 5 figs. Installation of a two-phase Rennerfelt furnace of 750-lb. capacity by Pacific Foundry Co. to utilize small pieces of waste iron such as nails, borings, etc.

Scrap Organization and Scrap Salvaging, Charles A. Reagan. Jl. Soc. Automotive Engrs., vol. 4, no. 1, Jan. 1919, pp. 47-48. Work of the Stores and Scrap Section of Ordnance Department; suggestions in regard to scrap segregation.

Waste Utilization

Possibilities in Saving and Utilizing Industrial Wastes, H. E. Howe. Indus. Management, vol. 57, no. 2, Feb. 1919, pp. 92-96. Points out three responsibilities of manufacturers: To use material of no higher grade than necessary for proper production of goods; to reclaim every particle where a salvaging process is known; to search for means to utilize wastes now thrown away.

TRANSPORTATION

Industrial Trucks

Shop Trucks. Am. Drop Forger, vol. 5, no. 1, Jan. 1919, pp. 18-22, 16 figs. Discussion and description of different types of industrial trucks.

Electric Truck as a Means of Shop Transportation. Can. Machy., vol. 21, no. 5, Jan. 30, 1919, pp. 103-105, 4 figs. Illustrates uses of electric storage battery trucks in industry for automatic transportation in loading and unloading ships and railway cars, and in the machine shop, tire factory, textile mill and electric wire insulating and manufacturing plants.

Industrial Electric Trucks, Tractors and Narrow-Gage Locomotives, Raymond J. Mitchell. Elecn., vol. 82, no. 2121, Jan. 10, 1919, pp. 51-57, 16 figs. Conditions under which electric trucks are to be desired; rapidity with which goods may be handled; main features of electric trucks now on the market; results achieved at the Natua Transfer Station of Pennsylvania Railway.

See also MINING ENGINEERING, Mines and Mining (Cars, Mine); MECHANICAL ENGINEERING, Handling of Materials; Hoisting and Conveying.

VARIA

Acceptances

Trade Acceptances in the Forging Trade, M. A. McCann. Am. Drop Forger, vol. 4, no. 12, Dec. 1918, pp. 475-477. Presents different phases of subject from viewpoint of salesman. Method of procedure explained.

Engineering Societies

American Engineers Locally and Nationally Associated, Alfred D. Flinn. Jl. Cleveland Eng. Soc., vol. 11, no. 3, Nov. 1918, pp. 163-173 and (discussion) pp. 173-178. Plea to engineering organizations to give earnest consideration to problem of coöperation; brief account of growth of Founder Societies and creation of Engineering Foundation; service given by the Engineering Societies Library; advisability of publishing an Engineering Societies periodical.

Engineers

What the War Has Done for Engineers, and the Part Engineers Have to Play in Reconstruction. Engineer, vol. 127, no. 3289, Jan. 10, 1919, pp. 41-42. Abstracted from the Presidential Address of R. E. B. Crompton before the Junior Institution of Engineers.

International Chapters

A New Factor in World Commerce, Richard S. Harvey. Textile World Jl., vol. 55, no. 2, Jan. 11, 1919, pp. 127 and 197. Considerations on advisability of forming international chapters for commercial corporations.

Social Problem

Organizing the State to Assist Individuals—A War Lesson (Die allgemeine Naehrpflicht in Licht der Kriegserfahrung), Max Singer. Zeitschrift des Oesterr. Ingenieur-und Architekten-Vereines, vol. 70, no. 38, Sept. 20, 1918, pp. 409-411, Part 1. Indorses the principles propounded by Josef Popper-Lynkeus, that it is the duty of the State to enable each individual to make a fair and useful living. Discusses solutions of the social problem. Part 2 in no. 39, concluded in no. 40, Oct. 4, 1918.

Industrial Technology

Alcohol

A New Opening for the Electrometallurgical Industry. The Manufacture of Alcohol from Calcium Carbide (Un nouveau débauché pour l'industrie électro-métallurgique. La fabrication de l'alcool en partant du carbure), Revue Générale de l'Electricité vol. 4, no. 24, Dec. 14, 1918, p. 934. A current of acetylene is passed over dilute solution of sulphuric acid having mercury salts as catalyser; resulting acetaldehyde is boiled and vapor passed over layer of finely powdered nickel. From Chemische Technische Wochenschrift, vol. 23, p. 55.

Ammonia

Commercial "Concentrated Ammonia-Liquor" and Its Impurities. H. G. Colman and E. W. Leoman, Jl. Soc. Chem. Indus., vol. 37, no. 24, Dec. 31, 1918, pp. 319T-323T and (discussion) 323T-324T. Analyses of samples from different plants.

Barium

Future of the Barium Industry—A Protective Tariff Required, Hugh Rollin. Mfrs. Rec., vol. 75, no. 3, Jan. 16, 1919, p. 97. Importance of industry and its present undeveloped stage in U. S. Paper before Am. Inst. Chem. Engrs.

Benzols

Analysis of Commercial "Pure" Benzols, F. Butler Jones. Jl. Soc. Chem. Indus., vol. 37, no. 24, Dec. 31, 1918, pp. 324T-327T, 2 figs. Experimental determination of depression of freezing point of benzene occasioned by presence of carbon bisulphide, thiophen, toluene and paraffin. A graph gives volume percentages of four solutes in terms of observed temperatures and specific gravity.

By-Products

Relation of By-Products to Chemical Industries, W. H. Blauvelt. Gas Age, vol. 43, no. 1, Jan. 1919, pp. 19-21, 2 figs. Industries built up by Semet-Solvay Co. to utilize by-product chemicals.

Carbide

Practical Points on Carbide Sizes. Jl. Acetylene Welding, vol. 2, no. 7, Jan. 1919, pp. 330 and 354. Method of classification according to sizes; relative value of different sizes of carbide. From Bulletin du Journal Suisse d'Acétylene.

Coal-Gas Products

Some Observations concerning (a) Liquid Purification of, and (b) the Simultaneous Recovery of Sulphur and Ammonia from Coal Gas, P. Parrish. Gas Jl., vol. 144, no. 2897, Nov. 19, 1918, pp. 413-418 and (discussion) pp. 418-420, 4 figs. Brief historical account; theoretical phases of processes; design and arrangement of plants; details of Trepex washer; principles governing dissociation; treatment of waste gases. Paper before Southern district Assn. Gas Engrs. & Mgrs.

Coal-Tar Industry Products, British

Progress in the British Coal Tar Industry, J. B. C. Kershaw. Gas Age, vol. 43, no. 2, Jan. 15, 1919, pp. 77-79, 2 figs. English practice in tar distillation and treatment of light oil fraction with dilute caustic soda; brief note on American methods of working up.

Coloring and Lacquering

Approved Practice in Coloring and Lacquering, James Sleetman. Brass World., vol. 14, no. 11, Nov. 1918, pp. 315-317, 6 figs. (Fourth and concluding article.)

Dust Recovery

Dust Recovery from Gas Scrubber Water. Blast Furnace, vol. 7, no. 1, Jan. 1919, p. 48, 1 fig. Dorr thickener installed in blast-furnace plant to provide automatically for settling of dust from gas scrubbers.

Enamels

The Control of the Luster of Enamels, Homer F. Staley. Jl. Am. Ceramic Soc., vol. 1, no. 9, Sept. 1918, pp. 640-647. Effect of crystallization, viscosity, concentrations, sulphur compounds and index of refraction on brilliancy of enamel. Suggestions given are based on considerations regarding chemical and physical phenomena taking place in manufacturing processes.

Fertilizers

Valuation of Fertilizers, J. Alan Murray. Jl. Soc. Chem. Indus., vol. 37, no. 23, Dec. 16, 1918, pp. 317T-318T. Proposes scheme of valuation based on formula, $x = k + np$ where x is price, k cost of production, p percentage of fertilizing ingredients, and n a coefficient which depends upon x and k.

France

Recent Progress and Future Possibilities of the Chemical Industry in France (Les progrès récentes et l'avenir des industries chimiques en France), Paul Razous. Génie Civil, vol. 73, no. 22, Nov. 30, 1918, pp. 429-433. Pharmaceutical products; petroleum distillation; conditions of growth for industry. (Concluded.)

Gas Manufacture

New Signaling Pyrometer a Means of Contending Against Effects of Inferior Labor. Am. Gas Eng. Jl., vol. 110, no. 2, Jan. 11, 1919, pp. 36-37, 2 figs. Lights inform attendant when damaging variation is approached.

The Utilization of Waste Heat in Gas Works (Die Gewinnung und Verwertung der Abwaerme im Gaswerksbetriebe). A technical and economic study by Director Wenger. Journal fuer Gasbeleuchtung, vol. 61, no. 43, Oct. 26, 1918, pp. 509-513, 3 figs. Continued from p. 501. Concluded Nov. 2. Description of experiments made to secure a higher yield of coke from coal. Waste heat used for heating water of municipal bathhouse.

Annual Report of Technical Inspection of Swiss Gas Works (Geschaeftsbericht des Technischen Inspektorates schweizerischer Gaswerke), Journal fuer Gasbeleuchtung, vol. 61, no. 43, Oct. 26, 1918, pp. 505-509, 2 figs. Covers 94 of the 96 gas works of Switzerland and describes equipment used, economies introduced to offset partly the excessively high cost of fuel, accidents, extraction of tar; safety rules and suggestions for further improvements.

Glass Pots

Observations on Apparent Causes of Failure of Lead Glass Pots, A. F. Gorton. Jl. Am. Ceramic Soc., vol. 1, no. 9, Sept. 1918, pp. 648-659. Examination of remains of pots leads writer to conclude that cracking and corrosion are chief causes of failure. Cracks attributed principally to insufficient preheating and corrosion to slagging action of iron on clay.

Helium

The Production of Helium from Natural Gas, Frederick G. Cottrell. Mech. Eng., vol. 41, no. 2, Feb. 1919, pp. 155-158 and 188, 6 figs. Reviews recent work in liquefaction and separation of gases and production of helium for use in balloons.

Lime

Reconstruction and Peace Time Problems of Lime Industry, Charles Warner. Concrete, Cement Mill Section, vol. 14, no. 1, Jan. 1919, pp. 7-9. Address by representative of War Service Committee on Lime at Peace Preparedness Congress.

Nitrogen Products

Nitrogen Industry in Germany during the War (L'industrie de l'azote en Allemagne pendant la guerre). Revue Générale de l'Electricité, vol. 5, no. 2, Jan. 11, 1919, pp. 75-76. Details of partial application of Birkeland-Eyde process and more extensive application of Ostwald process.

Industrial Electrochemical Manufacture of Nitrogenous Compounds: Nitric Acid and its Derivations, Cyanamide, Nitrides (La production électrochimique industrielle des composés nitrés: acide nitrique et derivés, cyanamide, azotures), Jean Escard. Revue Générale de l'Electricité, vol. 4. Scheme of installation for manufacturing nitric acid and nitrates from the air. Following furnaces and processes for producing synthetic nitric acid are described: Birkeland-Eyde, Schonherr, Pauling, Moscicki, Kilburn-Scott and Helbig. Dec. 28: Manufacture of cyanamide by reaction of nitrogen on calcium carbide; fixation of nitrogen in boron, magnesium and calcium nitrides; preparation and properties of these compounds.

Fixation of Nitrogen. Jl. Soc. Automotive Engrs., vol. 4, no. 1, Jan. 1919, pp. 16-17. Electric-arc process; building of concrete dam 100 ft. high and 1 mile long at Muscle Shoals to deliver 500,000 hp. for nitrogen-fixation work; cyanamid and Haber processes.

Note on the Bucher Cyanide Process for the Fixation of Nitrogen, Eugen Posnjak and H. E. Merwin. Jl. Wash. Acad. Sci., vol. 9, no. 2, Jan. 19, 1919, pp. 28-30. Experiments with varying amounts of sodium carbonate, carbon and iron; object to determine whether sodium cyanide was formed by Bucher's reaction.

Potash

Various Methods of Obtaining Potash. Commercial Fertilizer, vol. 17, no. 6, Jan. 1919, pp. 42-46. Developments since 1860.

Rubber

Imitation Caoutchoucs or Vulcanized Oils (Les caoutchoucs factices ou huiles vulcanisées), André Dubose. Chemie & Industrie, vol. 1, no. 7, Dec. 1, 1918, pp. 727-732. Historical note of development; processes of manufacture; classification.

Railroad Engineering

ELECTRIC RAILWAYS

Braking, Regenerative

Brake System with Recuperation of Energy for Vehicles Operated by Single-Phase Commutator Motors (Système de freinage avec récupération d'énergie pour véhicules actionnés par moteurs monophasés à collecteur), Behn-Eschenburg. Revue Générale de l'Electricité, vol. 4, no. 23, Dec. 7, 1918, pp. 877-881, 5 figs. Description and theory of system adopted at Oerlikon Construction Works for the Saint-Gothard locomotives, which permits operation of brakes with recuperation, at all loads and speeds. A coil of known reactance is only apparatus added to normal installation of motor. Also abstracted in Elecn., vol. 81, no. 2118, Dec. 20, 1918, pp. 708-710, 4 figs.

Coasting Clock

The Electric Coasting Clock. Ry. & Locomotive Eng., vol. 32, no. 1, Jan. 1919, pp. 22-23, 3 figs. Instrument which records actual number of minutes an electric train is operated without use of power or brakes.

Government Ownership

Public Ownership the Obvious Policy for Electric Railways, Richard McCullough. Elec. News, vol. 28, no. 1, Jan. 1, 1919, pp. 27-28. Analysis of present situation; advantages of public ownership to public and investor. Paper before Elec. Ry. Assn.

Locomotives

Oscillations of Electric Locomotives (Oscillations des locomotives électriques), P. Leboucher. Revue Générale de l'Electricité, vol. 4, no. 24, Dec. 14, 1918, pp. 914-930, 35 figs. Mathematical analysis of forces developed in members when continuous torque is transmitted by a crank.

Motor-Generator Sets

Performance of Motor-Generator Sets for the Chicago, Milwaukee & St. Paul Ry., F. T. Hague. Elec. Jl., vol. 16, no. 2, Feb. 1919, pp. 47-52, 11 figs. Power-factor curves of synchronous motor, temperature curves at full load and 1.5 load, and direct current short-circuit test at 9.25 load. Special reference is made to commutating machinery of large units.

Track Circuits

The Influence of Zinc Ties on Track Circuits. Ry. Age, vol. 66, no. 5, Jan. 31, 1919, pp. 305-306. Report of discussion at the convention of Ry. Signal Assn.

ELECTRIFICATION

Advantages

Railroad Electrification Facts and Factors, A. J. Manson. Ry. Elec. Engr., vol. 10, no. 1, Jan. 1919, pp. 3-4, 1 fig. Reason for adoption of electric motive power and advantages obtained from its use.

C., M. & St. P.

Chicago, Milwaukee and St. Paul Electrification in Washington, W. A. Scott. Elec. Rev., vol. 74, no. 1, Jan. 4, 1919, pp. 1618, 1 fig. Principal features of power, feeder and trolley lines, substation and locomotive equipment.

France

The Partial Electrification of the French Southern Railway (L'électrification partielle des chemins de fur de la Compagnie d'Orléans). Génie Civil, vol. 74, no. 1, Jan. 4, 1919, pp. 4-9, 4 figs. Program of the Paris & Orleans R. R. Conference before the Société d'Encouragement pour l'Industrie Nationale.

South Africa

S. A. R. Annual Report. S. A. Min. Jl. & Eng. Rec., vol. 28, pt. 1, no. 1416, Nov. 16, 1918, pp. 227-228. Electrification and control of shipping in South African Railways. From report of general manager of railways and harbors.

Western States

Transportation and Western Power Problems, John H. Lewis. Jl. Elec., vol. 42, no. 1, Jan. 1, 1919, pp. 14-15. Suggestions in regard to railway electrification and development of navigable streams.

EQUIPMENT

Cinder-Handling Plant

A New Type of Locomotive Cinder-Handling Plant. Ry. Age, vol. 66, no. 5, Jan. 31, 1919, pp. 319-320, 2 figs. Description of a plant for the Pittsburgh and Lake Erie at Hasleton Yard, Youngstown, O., which includes an inclined hoistway to a storage bin.

Coaling Station

New Philadelphia and Reading Coaling Station. Ry. Rev., vol. 64, no. 5, Feb. 1, 1919, pp. 174-176, 6 figs. Plant arranged to handle both anthracite and bituminous; elaborate sand-handling features; general description of what is believed to be the largest concrete coaling station in the world.

FOREIGN

British

British Railways Under War Conditions. Engineer, vol. 126, no. 3283, Nov. 29, 1918, pp. 454-455, Railwaymen with the colors. (Tenth Article)

Government Ownership, British

Nationalization of British Railways. Ry. Gaz., vol. 29, no. 24, Dec. 13, 1918, pp. 671-674, 1 fig. Factors bearing on policy of railroad Government ownership; discussion of basis for arriving at price which will be fair alike to State and shareholders.

Peru

Peru and Its Principal Railways, Clayton Sedgwick Cooper. Ry. Rev., vol. 64, nos. 1 and 2, Jan. 4 and 11, 1919, pp. 1-5, 6 figs. and pp. 61-65, 8 figs. Geography and history of railway construction in Andes.

LOCOMOTIVES

British Express

The New Express Engines of the London & South-Western Railway. Ry. Gaz., vol. 29, no. 14, Dec. 13, 1918, pp. 662-669, 13 figs. Sectional drawings, photographic illustrations, general dimensions and data of 4-6-0 passenger locomotives recently completed at Eastleigh Works.

Diesel-Electric

Diesel-Electric Locomotives (Automotrices Diesel-électriques). Bulletin Technique de la Suisse Romande, year 44, nos. 14, 15, 16 and 17, July 13 and 27, Aug. 10 and 24, 1918, pp. 129-132, 137-140, 145-149 and 157-158, 13 figs. Extensive descriptions of mechanical arrangement and electrical schemes. A Diesel engine operates a d.c. dynamo; current from dynamo feeds traction motors; Ward-Léonard system followed. Abstract in Revue Générale de l'Electricité, vol. 4, no. 23, Dec. 7, 1918, pp. 891-896, 6 figs.

Feedwater Heating

Locomotive Feed Water Heating, H. S. Vincent. Ry. Mech. Eng., vol. 93, no. 1, Jan. 1919, pp. 44-47, 4 figs. Discussion of exhaust-steam and waste-gas methods of preheating for locomotive boilers. (Second article.)

Fireboxes

A New Departure in Firebox Construction. Ry. Rev., vol. 64, no. 2, Jan. 11, 1919, pp. 47-51, 5 figs. Means of taking advantage of principle of radiant heat transfer.

Lubricators

Force Feed Lubricator. Ry. & Locomotive Eng., vol. 32, no. 1, Jan. 1919, pp. 11-12, 1 fig. Records obtained with Schlacks system of forced-feed lubrication as applied to locomotives.

Mallet

The U. S. Standard Light Mallet Type Locomotive. Ry. Age, vol. 66, no. 5, Jan. 31, 1919, pp. 290-292, 4 figs. 2-6-6-2 wheel arrangement with weight on drivers of 358-000 lb. and tractive effort, compound, of 80,000 lb. Description with principal data and drawings.

Mallet Type Locomotive for Utah Railway. Ry. Rev., vol. 64, no. 3, Jan. 18, 1919, pp. 85-86, 1 fig. Description with principal data of articulated compound built for heavy freight and pusher service.

Mountain Type

Mountain Type Locomotives for the Atchison, Topeka & Santa Fe. Ry. & Locomotive Eng., vol. 32, no. 1, Jan. 1919, pp. 3-4, 1 fig. Particulars of 4-8-2 type recently completed at Baldwin Locomotive Works.

New Zealand Narrow Gage

Express Locomotives for 3-ft., 6-in. Gauge. Engineering, vol. 106, no. 2760, Nov. 22, 1918, pp. 576-579, 31 figs. Principal data, drawings of details, test results and general description of certain locomotives on New Zealond Government Railways.

Pennsylvania 2-10-2

Heaviest 2-10-2 Type Built for Pennsylvania Lines. Ry. Age, vol. 66, no. 4, Jan. 24, 1919, pp. 249-251, 4 figs. Principal data, drawings and description.

Rock Island 2-10-2

Rock Island 2-10-2 Locomotive. Ry. Mech. Eng., vol. 93, no. 1, Jan. 1919, pp. 41-43, 5 figs. New designs of cab and spark arrester; grease lubrication used on crossheads and trailer.

Stokers

New Locomotive Stoker Tested Out on Erie. Ry. Age, vol. 66, no. 3, Jan. 17, 1919, pp. 202-204, 4 figs. Mechanical distribution of coal; maintains light fire and reduces cinder and standby losses.

The Elvin Mechanical Stoker for Locomotives. Ry. Rev., vol. 64, no. 4, Jan. 25, 1919, pp. 132-134, 4 figs. Important features are minimum power requirements and a mechanical means of fuel distribution.

Switches, Geared

Lima Locomotive in Switching Service With the Tennessee Coal, Iron and Railway Company. Ry. & Locomotive Eng., vol. 32, no. 1, Jan. 1919, pp. 10-11, 2 figs. Service given by geared locomotive in industrial switching; its special advantages.

Tenders

Canadian Pacific Railway Locomotive Tenders. Can. Ry. & Marine World, no. 251, Jan. 1919, pp. 11-12, 4 figs. Coal container with slope and bottom sheets independent of tank. Coal automatically delivers itself at shovel sheet without coal passer.

Thermic Siphons

Chicago, Milwaukee & St. Paul Railway Test of Locomotive Equipped with the Nicholson Termic Syphons. Ry. & Locomotive Eng., vol. 32, no. 1, Jan. 1919, pp. 7-9, 1 fig. Principal dimensions, data and performances of two engines. Firebox of one was equipped with Nicholson thermic syphons supporting brick arch; other had ordinary type of arch supported on four 3-in. arch tubes.

Tires

Shrinkage of Locomotive Tyres. Ry. Gaz., vol. 29, no. 25, Dec. 20, 1918, pp. 703-704, 1 fig. Methods adopted at Doncaster Works for determining tire shrinkage and for checking allowance of tires.

U. S. Standard

Two More Standard Locomotives. Ry. Mech. Eng., vol. 93, no. 1, Jan. 1919, pp. 25-30, 12 figs. Heavy 4-8-4 and light 2-10-2 types are well proportioned and have essentially same boiler.

Standard 2-10-2 and 2-8-2 Type Locomotives. Ry. Rev., vol. 64, no. 1, Jan. 4, 1919, pp. 7-12, 9 figs. Principal data and drawings with general description. Two government standard engines whose boilers come nearest interchangeability.

New Locomotives of Standard Design. Boiler Maker, vol. 19, no. 1, Jan. 1919, pp. 1-2, 4 figs. Dimensions of four locomotives recently delivered to U. S. R. R. Administration. Totals of boiler-heating surfaces vary from 1891 to 4285 sq. ft.

NEW CONSTRUCTION

Avlona-Monastir

Avlona-Monastir Railroad Project (Proyecto del ferrocarril Avlona-Monastir). Revista de Obras Publicas, year 66, no. 2257, Dec. 26, 1918, pp. 645-647, 2 figs. General plan for consolidation of various lines into a Trans-Balkan Italian System with ferry boat service across Otranto Canal. From Giornale del Genio Civile.

Kalka-Simla

The Kalka-Simla Railway and Rolling Stock. Engineer, vol. 126, no. 3283, Nov. 29, 1918, pp. 455-458, 18 figs. General illustrated description of railway and of rolling stock.

Katanga

The Katanga Railway. Engineer, vol. 126, no. 3285, Dec. 13, 1918, pp. 501-504, 17 figs. Description of its construction, some engineering features and equipment.

OPERATION AND MANAGEMENT

British

British Railways Under War Conditions. Engineer, vol. 126, no. 3286, Dec. 20, 1918, pp. 528-529. The dispatch of the expeditionary force. Vol. 127, no. 3289, Jan. 10, 1919, pp. 38-39. The first six months.

Freight Handling

Proper Methods of Handling Freight, E. P. Nowlin. Ry. Rev., vol. 64, no. 1, Jan. 4, 1919, pp. 5-6. Introducing scheme of reorganization whereby to reduce loss and damage expense.

French

French Railroads During the War (Los ferrocarriles franceses durante la guerra) Boletin de Minas, vol. 10, nos. 7-9, Sept. 30, 1918, pp. 106-110. Organization and operation. Executive direction of each road in hands of a commission composed of a military officer and a technical expert. From documents published by Chamber of Commerce, Paris, June, 1918

Post-War Conditions

The Railway Situation Created by the War (La crisis ferroviaria antes de la guerra y situacion creada por esta). Revista de Obras Publicas, year 66, no. 2246, Oct. 10, 1918, pp. 509-514. Points out critical financial condition of railways in Spain and generally throughout the world, shown by constantly diminishing scale of profits due to rising expenses for fuel, labor and materials. Financial results obtained by railway working in France, England and Germany for period 1901-1911 are given in tabular form.

Supervision

Supervision, J. L. Wilkes. Ry. Club of Pittsburgh, vol. 18, no. 1, Dec. 19, 1918, pp. 6-17 and (discussion) pp. 17-26. Duties of railroad supervisors; qualifications required to fill position completely; suggestions to supervisors in regard to efficiency in discharge of their functions.

U. S. Railroad Administration

The Federal Railroad Administration of the United States, W. M. Acworth. Ry. Gaz., vol. 29, no. 24, Dec. 13, 1918, pp. 651-660. Historical account of conditions in the railroads during the years of the war, specially since the Government took over their operation. Compiled from newspapers, unofficial reports, private correspondence, and public documents.

PERMANENT WAY AND BUILDINGS

Landslip

A Railway Landslip. Times Eng. Supp., no. 530, Dec. 1918, p. 253. Incidents attending movement of wall at Wembley on Great Central Ry.; method of reconstruction.

Montreal Tunnel

The Canadian Northern Railway's Montreal Tunnel from an Economic Point of View, H. K. Wicksteed. Can. Ry. & Marine World, no. 251, Jan. 1919, pp. 1-5, 1 fig. Economical considerations which decided on selection of tunnel route at Montreal with general reference to economical aspect of tunnel construction in railway lines.

Spikes

Screw-Spikes versus Dog-Spikes. Indian Eng., vol. 64, no. 16, 17, 18, 19 and 20, Oct. 19, 26, Nov. 2, 9, 16, 1918, pp. 223-224, 237-238, 251-252, 265-266, 279-280. Reports of experience on Indian railways of comparative efficiency of dog-spikes and screw-spikes for hard and soft wood sleepers. Following points are touched: holding power, gage keeping, creep holding, ease of maintenance and estimated comparative costs, relative advantages in construction, and relative cracking effect on sleepers. (To be continued.)

Water Tanks

Concrete Railway Water Tanks. Ry. Gaz., vol. 29, no. 26, Dec. 27, 1918, p. 728, 2 figs. Details of type commonly used for settling basins.

RAILS

Corrugation

Rail Corrugation. Ry. Gaz., vol. 29, no. 26, Dec. 27, 1918, pp. 725-728, 3 figs. Wheel tire is provided with groove, the corners of which present angular cutting edge or edges. This form is said to prevent tendency of rails to develop corrugation.

ROLLING STOCK

Couplers

Development and Construction of Standard Couplers. Ry. & Locomotive Eng., vol. 32, no. 1, Jan. 1919, pp. 5-6, 4 figs. Review of work done by committees of Master Car Builders' and Master Mechanics' Assns. to tandardize various parts and contour of couple.

Northern Pacific Box Cars

Northern Pacific Builds Box Cars. Ry. Mech. Eng., vol. 93, no. 1, Jan. 1919, pp. 37-40, 7 figs. Interesting design of underframe and end on cars being constructed in company shops.

Timber

Use of Treated Timber in Car Construction. Ry. Age, vol. 66, no. 5, Jan. 31, 1919, pp. 295-298. Influence of decay on life of wooden car parts, methods of treating and results secured. From a report presented at the convention of the Am. Wood Preservers' Assn.

Trucks

Car Trucks, L. Brown. Can. Ry. Club, vol. 17, no. 9, Dec. 1918, pp. 17-28 and (discussion) 28-35, 1 fig. Manufacture and mounting of wheels; uses of Master Car Builder's standard mounting; preparation of journal bearings and dust guards; requirements of bolsters; location of brakes.

SAFETY AND SIGNALING SYSTEMS

Car Repairmen

To Prevent Injuries to Car Repairers, H. W. Johnston. Official Proc. Car Foremen's Assn., Chicago, vol. 14, no. 3, Dec. 1918, pp. 13-25, 4 figs. Records of accidents on N. Y. C. R. R. show that accidents are minimized by careful observation of practices of employees and thoughtful instruction of new men as to hazards peculiar to work: hence responsibility for accidents is placed on foremen.

Grade Crossings

The Prevention of Accidents at Grade Crossings, C. L. Addison. Am. City, vol. 20, no. 1, Jan. 1919, pp. 7-10, 1 fig. Plan of the grade-crossing publicity campaign conducted by Long Island R. R. Co.; means of grade-crossing protection.

SHOPS

Balboa Shops

War Time Work at Balboa Shops, Panama Canal, R. D. Gatewood. Am. Mach., vol. 50, no. 5, Jan. 30, 1919, pp. 191-194, 11 figs. A brief description of some of the great variety of work being done at the Balboa shops.

Supervision

Efficient Supervision of Railroad Shops, Frank McManamy. Boiler Maker, vol. 19, no. 1, Jan. 1919, pp. 4-5. Locomotive mileage increased by speedy repair work at roundhouse; essentials of adequate supervision; responsibility of executives.

Welding

Arc Welding in Railroad Shops, B. C. Tracy. Gen. Elec. Rev., vol. 21, no. 12, Dec. 1918, pp. 887-898, 20 figs. Describes more important applications of electric welding in making locomotive repairs.

West Burlington Shops

West Burlington Shops of the C. B. & Q. Ry. Mech. Eng., vol. 93, no. 1, Jan. 1919, pp. 5-16, 21 figs. Equipment and operation of new erecting and machine shop, blacksmith shop and power plant.

SPECIAL LINES

Narrow-Gage Railroads

Narraw-Gage Railroads (Chemins de fer à voie étroite), G. Mangin. Génie Civil, vol. 73, no. 26, Dec. 1918, pp. 504-510, 32 figs. Material used in construction of German strategical military railways. Gage 23.6 in. (60 cm.). Data taken from inspection of evacuated areas. Organization of road construction given from official documents left in field by retreating Germans. Supplements article in Génie Civil, vol. 72, no. 14, Apr. 6, 1918, p. 229.

STREET RAILWAYS

Emergency Work

Some Emergency Special Work Construction, Thomas B. McMarth. Elec. Ry. Jl., vol. 53, no. 3, Jan. 18, 1919, pp. 145-146, 4 figs. Indianapolis company utilizes acetylene cutting and thermit welding in building up curve crosses.

Fares

Is the Zone System the Fare Solution? Thos. Conway, Jr. Elec. News, vol. 27, no. 24, Dec. 15, 1918, pp. 29-31. Comparison of fare collection and regulation systems used in U. S. Paper before Am. Elec. Ry. Assn. Also in Street Ry. Bul., vol. 18, no. 12, Dec. 1918, pp. 519-521.

Franchises

Features of Service-at-Cost Plan Franchise. Elec. News, vol. 28, no. 1, Jan. 1, 1919, pp. 29-30. Ordinance containing following principal provisions: General transfer system; complete control of service and operation by city; right of city to reroute; authority of council to order extensions and establish new and additional routes; and franchise tax to be paid to city.

Motors, High-Power

High Power Motors in Tramway Service (Sur l'emploi de moteurs puissants par les tramways), Lucien Pahin. Industrie Electrique, year 27, no. 636, Dec. 25, 1918, pp. 464-467, 6 figs. Equipment of 95-hp. Westinghouse motors used by the Compagnie de Chemins de fer de Paris.

Skip Stops

Skip-Stop Proves Safety Measure. Electric Traction, vol. 15, no. 1, Jan. 15, 1919, pp. 4-6, 3 figs. Diagrams showing reduction in hazard of collisions and boarding and alighting with skip-stop operation, prepared from records of Detroit United Ry.

Tests

Car Equipment Service Tests Determine Fitness of Apparatus, C. W. Squier. Elec. Ry. Jl., vol. 53, no. 3, Jan. 18, 1919, pp. 128-133, 12 figs. Method of making operating tests and heat runs; how sections of track can be best laid out to represent actual service requirements; organization necessary for proper test force; results obtained in specific case.

Track Circuits

Leakage Resistance of Electric Railway Roadbeds, E. R. Shepard. Elec. Ry. Jl., vol. 53, no. 4, Jan. 25, 1919, pp. 172-178, 7 figs. Results of tests covering a period of more than three years made upon railway tracks in Washington, D. C., and upon short sections of experimental track on the Bureau of Standards grounds.

Track Construction

Removing Old Paving for New Track Construction, C. W. Geiger. Elec. Traction, vol. 15, no. 1, Jan. 15, 1919, pp. 30-31, 8 figs. To cut through asphalt a flange was heated and shrunk onto roller of a heavy steam-roller; flange was then sharpened so as to cut down through asphalt when roller was run over it.

TERMINALS

Cleveland Union Station

Union Depot Project for Cleveland, W. E. Pease. Jl. Cleveland Eng. Soc., vol. 11, no. 3, Nov. 1918, pp. 179-185 and (discussion) pp. 185-191. Studies of traffic movements undertaken at New York preliminary to designing some of its terminals; application to conditions in Cleveland.

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Erie

New Car Barn and Trainmen's Room at Erie, H. P. Amthor. Elec. Traction, vol. 15, no. 1, Jan. 15, 1919, pp. 15-19, 4 figs. Description of terminal of Buffalo & Lake Erie Traction Co., giving details of construction, type of skylight, pit construction and method of fastening rails to pit piers.

Richborough

The Richborough Transportation Depot and Train Ferry Terminus. Engineer, vol. 127, no. 3289, Jan. 10, 1919, pp. 31-34, 9 figs. Construction; railway facilities; traffic organization; signalling arrangements; rolling stock; barge and train ferry services.

St. John, N. B.

The Railway Terminals, etc. at St. John, N. B., C. C. Kirby. Can. Ry. & Marine World, no. 251, Jan. 1919, pp. 9-11, 1 fig. Problem of their future extension to meet development of port.

Sebastopol, Cal.

New Passenger Depot at Sebastopol, California. Elec. Traction, vol. 15, no. 1, Jan. 15, 1919, pp. 19-21, 2 figs. Layout of station of central point where railroad radiates in three directions.

Munitions and Military Engineering

Anti-Submarine Devices

The American Destroyer. Sci. Am., vol. 119, no. 26, Dec. 28, 1918, p. 515, 3 figs. 1200-ton destroyer, depth bomb and other accessories which have contributed to the destruction of U-boats.

Camps

Engineering Features of Camp Dodge, L. P. Wolff. Bul. Affiliated Eng. Societies Minn., vol. 3, no. 12, Dec. 1918, pp. 208-220, 1 fig. Waterworks; sewerage system; railroads; streets and highways; heating.

Gun Mounts

Making Naval Gun Mounts, Franklin D. Jones. Machy., vol. 25, no. 6, February 1919, pp. 485-492, 17 figs. First of two articles describing special tools, gages and fixtures used at the plant of the Mead-Morrison Mfg. Co., where 1000 complete mounts for 4-inch guns are being constructed for the United States Navy.

Hand Grenades

Making the American Hand Grenade, Edward K. Hammond. Machy., vol. 25, no. 6, February 1919, pp. 519-524, 18 figs. Second of two articles on methods of machining and loading the bodies and assembling the bouchons.

Howitzers

How a 155-Mm. Howitzer is Made, J. V. Hunter. Am. Mach., vol. 50, nos. 5 and 6, Jan. 30 and Feb. 6, 1919, pp. 199-204 and 249-252, 32 figs. The breech.

Inspection

The Inspector's Standpoint in Munition Production, John T. Marsh. Jl. Cleveland Eng. Soc., vol. 11, no. 3, Nov. 1918, pp. 131-152, 9 figs. Qualifications required by inspectors; conditions likely to be found in relations between manufacturers and inspectors; rejections for pipe; duties of inspectors in regard to brinelling.

Lewis Machine Gun

The Manufacture of the Lewis Machine Gun, Frank A. Stanley. Am. Mach., vol. 50, no. 2 Jan. 9, 1919, pp. 55-60, 17 figs. The radiator, locking piece and magazine. (Fourteenth article.)

Motor Transport

Engineering Division of the Motor Transport Corps, John Younger. Jl. Soc. Automotive Engrs., vol. 4, nos. 1 and 2, Jan. and Feb. 1919, pp. 5-8 and 77-85, 2 figs. Jan.: Functions of engineering division; organization scheme; work of technical service branch. Feb.: Function of design section, standardized directions for heat treatment of steel; chemical analysis and physical properties of carbon steel; chart of steel specifications, chemical and physical properties.

Ordnance Depot

Huge Steel Buildings at Ordnance Base Depot in France, Robert K. Tomlin. Eng. News-Rec., vol. 82, no. 3, Jan. 16, 1919, pp. 124-129, 10 figs. Project includes both shops and warehouses; all material supplied from United States; transmission line built to supply electric power for machine-tool operation.

Railway Batteries

The 14-in. Naval Railway Batteries, C. L. McCrea. Am. Mach., vol. 50, no. 4, Jan. 23, 1919, pp. 141-149, 11 figs. Story of design, construction, shipping, reërecting abroad and placing in action on the fighting front of the U. S. Navy's 14-in. guns on railway mounts.

Railways

Our Railway War Forces Aboard. Ry. Mech. Eng., vol. 93, no. 1, Jan. 1919, pp. 19-22, 6 figs. Account of problems encountered in France and shop facilities for erecting equipment.

Shell Manufacture

Unique Shell-Profile Turning Attachment, Donald A. Baker. Am. Mach., vol. 50, no. 4, Jan. 23, 1919, pp. 161-162, 1 fig. Design made to start cut at small end of shell, turn the radius and continue to turn parallel until disengaged.

High Explosive Shells and Shrapnel, J. M. Hall. Am. Drop Forger, vol. 4, no. 12, Dec. 1918, pp. 500-504. How shells are heat treated; physical and chemical requirements; heating of steel for forgings. From paper presented before Steel Treating Research Soc.

Manufacture of Six Inch High Explosive Shells for the United States Army, T. D. Lynch. Elec. Jl., vol. 16, no. 1, Jan. 1919, pp. 17-25, 23 figs. Description of Shadyside Plant of Westinghouse Electric & Mfg. Co., equipped to manufacture 6-in. shells at the rate of 3000 per day, working day and night.

Shell-Manufacturing Tools

Special Tools for Shell Manufacture, George A. Neubauer and Erik Oberg. Machy., vol. 25, no. 6, February 1919, pp. 534-537, 12 figs. Second of two articles describing a number of devices used by the Buffalo Pitts Co.

See also METALLURGY, Iron and Steel (Molybdenum Steel); MECHANICAL ENGINEERING, Motor-Car Engineering (Tanks).

General Science

CHEMISTRY

Analytical Chemistry

Method of Least Squares Applied to Estimating Errors in Coal Analysis, J. D. Davis and J. G. Fairchild. Department of Interior, Bur. of Mines, Tech. Paper 171, 36 pp., 6 figs. Following limits of error are calculated: for sampling, 0.20 per cent; for ash determination, 0.40 cent; for moisture determination, 0.20 per cent; for heating-value determination, 0.75 per cent. Thus writers conclude that limits allowed by committee on coal analysis of Am. Soc. Testing Materials represent values within which a large percentage of errors will actually fall.

Flame Reactions

Flame Reactions: Selenium and Tellurium in the Hydrogen-Air Flame, Jacob Parish. Jl. Phys. Chem., vol. 22, no. 9, Dec. 1918, pp. 640-646. Extension of writer's previous experiments (Jl. Phys. Chem., 22, 430, 1918) to behavior of selenium dioxide, tellurium dioxide, hydrogen telluride, and of elements themselves, in hydrogen-air flame.

Physical Chemistry

Physical Chemistry and Its Bearing on the Chemical and Allied Industries, James C. Philip. Jl. Roy. Soc. Arts, vol. 67, nos. 3450 and 3452, Jan. 3 and 17, 1919, pp. 94-102 and 122-131, 1 fig. Jan. 3: Factors which determine equilibrium in a reversible reaction; thermodynamic equation expressing influence of temperature on equilibrium constant of a reaction, and its relation to heat effect of reaction. Jan. 17: Laws and principles governing absorption of gases and dissolved substances.

Structure of Matter

The Atomic Weight of Lead from Samarskite, Arthur L. Davis. Jl. Phys. Chem., vol. 22, no. 9, Dec. 1918, pp. 631-639. Separation of lead from samarskite, its purification, and determination of its atomic weight by means of analyses of lead chloride; parallel experiments with ordinary lead and comparison of relative values under same conditions of experimentation; correlation of results with theory of radioactive changes involved by determination of percentages of uranium and thorium.

The Determination of the Molecular Complexity of Liquid Sulphur, Alex. Mitchell Kellas. Jl. Chem. Soc., vols. 113 and 114, no. 674, Dec. 1918, pp. 903-922, 4 figs. Series of experiments to determine surface tension of liquid sulphur between melting point and boiling point by means of capillary tubes.

Ultra-Violet Light

Ultra Violet Light. Its Application in Chemical Arts—XX, Carleton Ellis and A. A. Wells. Chem. Engr., vol. 26, no. 13, Dec. 1918, pp. 505-506 and 521. Ultra violet absorption of aliphatic ketones and aldehydes. Compilation of researches by different experiments.

MATHEMATICS

Elliptical Functions

Elementary Solution of the Inversion of Elliptical Functions (Solution élémentaire du problème de l'inversion des fonctions elliptiques), René Garnier. Comptes rendus des séances de l'Académie des Sciences, vol. 167, no. 22, Nov. 25, 1918, pp. 748-750. Generalization of Landen's transformation.

Logarithms

Logarithms of Hyperbolic Functions to Twelve Significant Figures, Frederick E. Pernot and Baldwin M. Woods. Univ. of Cal. Publications in Eng., vol. 1, no. 13, Nov. 16, 1918, pp. 297-467. Tables of logarithms to base 10 of three principal hyperbolic functions for range from 0 to 2 with tabular interval of 0.001, and auxiliary tables of log (sinh x/x) and log (x/tanh x) for range from 0 to 5 with same tabular interval.

PHYSICS

Capillary Layers

Thickness and Structure of a Capillary Layer of a Liquid in Contact with Its Saturated Vapor (Die Dicke und Struktur der Kapillarschicht einer Fluessigkeit in Beruehrung mit ihrem gesattigten Dampf), G. Bakker. Annalen der Physik, vol. 54, no. 20, 1917, pp. 245-295, 5 figs. Discussion of potential function of the forces of attraction. Application to thermodynamics. Comparison of theoretical results in the experimental determinations made on gases, hydrocarbons, water, alcohols, including their freezing points. Mathematical treatment.

Compressibility of Solutions

Compressibility of Aqueous Solutions, Especially of Urethane, and the Polymerization of Water, Theodore W. Richards and Sven Palitzsch. Jl. Am. Chem. Soc., vol. 41, no. 1, Jan. 1919, pp. 59-61, 1 fig. Compressibilities of aqueous solutions of urethane were measured at 20 deg. cent. over pressure range from 100 to 300 megabars, as were also surface tension, specific volume and viscosity. Bearing of results on theory of Harold Whiting ascribing polymerization to water is emphasized.

Heat Conductivity

Experiments on the Heat Conductivity of Gases (Experimentelle Untersuchungen ueber die Waermeleitfaehigkeit der Gase), Sophus Weber. Annalen der Physik, vol. 54, no. 21, 1917, part 1, pp. 325-356, 9 figs.; no. 22, part 2, pp. 437-462, 2 figs. Theory and correction factors employed in accurate determinations of heat conductivity using an electric calorimeter which is a modified Schleiermacher apparatus, applied to air and pure gases at various pressures and suitable for other insulators. For dry air with convection and CO_2 eliminated, $K_0 = 0.00005681$ gram calories, deg. cent., sq. cm. In part 2 is given the heat conductivity of hydrogen, neon, helium, argon, nitrogen, oxygen, methane, CO_2, N_2O. Tests were conducted at the incandescent lamp works of N. V. Philips, Eindhoven, Holland.

Internal Friction

On the Interior Friction of Quartz Fibers at Low Temperatures (Remarque sur le frottement intérieur des fils de quartz aux basses températures), C-E. Guye and P. Barbier. Archives des Sciences Physiques et Nautralles, vol. 46, Dec. 1918, pp. 326-328. Experiments to determine cause of slow variation of internal friction as temperature diminishes from —80 to —194 deg. cent.

Radiations

The Gamma Ray Activity of Thorium, D. Herbert N. McCoy and G. H. Cartledge. Jl. Am. Chem. Soc., vol. 41, no. 41, Jan. 1919, pp. 50-53. Determination of Th D: The ratio in order to ascertain whether combined mesothorium and thorium D activities would give total γ activity.

Sound Waves, Reflected

Submarine Range-Finding by Means of Reflected Sound Waves. Sci. Am., vol. 120, no. 4, Jan. 25, 1919, pp. 67 and 82. Modification by Elias Ries of his apparatus for accurate positioning of icebergs. Subaqueous device consists of two megaphone receivers pivoted at ends of horizontal arm and a sound projector mounted in center; operation similar to that of aerial apparatus.